Factors Behind Creditless Recoveries – Country Group Comparison

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Abstract

The role of bank credit in shaping economic recoveries has been the subject of a growing body of literature, especially in the aftermath of the global financial crisis of 2007-2009. Generally, bank lending is thought to be an important source of finance that supports economic growth, indicating that output and bank credit should always move in the same direction. However, the evidence shows that creditless recoveries – episodes in which output recovers without the growth of bank credit – have been common both in advanced as well as in emerging and developing economies. Thus, a more detailed examination of this phenomenon is important to improve our understanding of the nature of creditless recoveries that have been found to be weaker and more protracted than normal recoveries.

This thesis analyzes the main determinants of creditless recoveries in (i) advanced and (ii) emerging and developing economies and compares the differences between these country groups. The key determinants of creditless recoveries are studied by using a panel probit estimation method. The data sample includes 32 advanced and 105 emerging and developing economies in the period of 1980-2015. This thesis adds value to existing literature by taking the global financial crisis of 2007-2009 into account. Particular focus will be given to analyzing advanced economies, which have gained less attention in the existing literature.

The empirical results of this thesis suggest that a banking crisis that preceded a recession seems to be a major factor increasing the probability of creditless recoveries in both country groups. Furthermore, the results from advanced economies indicate that declining investments preceding an economic downturn will significantly increase the likelihood of creditless recoveries. On the contrary, the findings from emerging and developing economies suggest that sizeable contractions in real GDP as well as currency crises are likely to increase the probability of creditless recoveries.

The existing literature offers several hypotheses that might, at least partly, explain the obtained empirical results. A banking crisis typically forces banks to clean up their balance sheets and thus reduce lending, which in turn is likely to increase the probability of creditless recoveries in both country groups. The differences in results between the country groups have been commonly explained as a result of the divergent progress of financial markets. It is likely that advanced economies have more developed financial markets which makes it easier for firms to exploit alternative funding sources. In the event of a liquidity crunch, firms may boost their liquidity and eventually output by curtailing investments and thus borrowing. Creditless recoveries may also be explained by a shift from more to less credit-intensive activities.

Keywords
creditless recovery, probit model, bank lending, recession

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Tiivistelmä

Erityisesti vuosien 2007-2009 globaalin finanssikriisin jälkeen pankkiluotonannon roolia talouden elpymisen kannalta on tutkittu kirjallisuudessa yhä enenevissä määrin. Yleisesti pankkiluotonannon ajatellaan olevan merkittävä rahoituslähde, joka osaltaan tukee talouskasvua. Näin ollen tuotannon ja pankkiluotonannon pitäisi liikkua aina samaan suuntaan. Todisteet kuitenkin osoittavat, että luotottomat elpymiset – episodit, jossa tuotanto elpyy ilman pankkiluotonannon kasvua – ovat olleet yleisiä niin kehittyneissä maissa kuin myös nousevissa talouksissa ja kehitysmaissa. Täten ilmiön yksityiskohtaisempi tutkiminen on tärkeää parantaaksemme ymmärrystä luotottomien elpymisten luonteesta, sillä niiden on havaittu olevan heikompia ja pitkittyneempiä kuin normaalien elpymisten.

Tutkielma analysoi luotottomien elpymisten keskeisimpiä määrittäviä tekijöitä (i) kehittyneissä talouksissa ja (ii) nousevissa talouksissa ja kehitysmaissa, ja vertailee eroja näiden maaryhmien välillä. Näitä tekijöitä tutkitaan käyttämällä estimointimenetelmänä probit-mallia paneeliaineistoa hyödyntäen. Aineisto sisältää 32 kehittynyttä maata sekä 105 nousevaa taloutta ja kehitysmaata vuosina 1980-2015. Tutkielma tuo lisäarvoa olemassa olevan kirjallisuuden ympärille huomioimalla vuosien 2007-2009 globaalin finanssikriisin. Lisäksi analyysi keskittyy enemmän kehittyneisiin maihin, jotka ovat jääneet vähemmälle huomiolle aiemmassa kirjallisuudessa.

Tutkielman empiiristen tulosten mukaan taantumaa edeltävä pankkikriisi vaikuttaa kasvattavan merkittävästi luotottomien elpymisten esiintyvyyden todennäköisyyttä kummassakin maaryhmässä. Lisäksi tulosten mukaan taantumaa edeltävä investointien lasku kasvattaa merkittävästi luotottomien elpymisten todennäköisyyttä kehittyneissä maissa. Vastaavasti tulokset nousevista talouksista ja kehitysmaista viittaavat siihen, että reaalisen BKT:n voimakas supistuminen sekä valuuttakriisit kasvattavat luotottomien elpymisten todennäköisyyttä.

Olemassa oleva kirjallisuus tarjoaa useita hypoteeseja, jotka saattaisivat ainakin osittain selittää empiirisiä tuloksia. Tyypillisesti pankkikriisi pakottaa pankit puhdistamaan taseitaan ja sitä myöten vähentämään luotonantoa, joka puolestaan todennäköisesti lisää luotottomien elpymisten todennäköisyyttä kummassakin maaryhmässä. Eroja tuloksissa maaryhmien välillä on usein perusteltu eroilla rahoitusmarkkinoiden kehittyneisyydessä. On todennäköistä, että kehittyneiden talouksien kehittyneemmät rahoitusmarkkinat helpottavat yritysten mahdollisuuksia hyödyntää muita vaihtoehtoisia rahoituslähteitä. Likviditeettiromahduksen kohdatessa yritykset voivat parantaa likviditeettiään ja lopulta tuotantoa investointeja ja siten lainanottoa supistamalla. Luotottomia elpymisiä on selitetty myös siirtymällä luottointensiivisistä toiminnoista vähemmän luottointensiivisiin toimintoihin.

Avainsanat
luototon elpyminen, probit malli, pankkiluotonanto, taantuma

Contents

1 Introduction

Economic recovery has been in the forefront of economic research especially in the aftermath of the global financial crisis of 2007–2009. The world economy contracted for the first time since World War II in 2009, and the implications of the crisis are still evident in several countries. Differences in economic recovery among countries have been substantial. While some countries reached their pre-crisis real GDP level rather quickly, some others, such as Finland, Italy and Spain, are still suffering from lower levels of real GDP. Generally, financial crises tend to lead to severe macroeconomic and financial costs. According to Claessens and Kose (2013), the influence of financial crises on the real economy typically contains large output losses and contraction of consumption and investment. They also argue that financial crises are usually associated with large downward corrections in financial variables, such as credit or asset prices.

An important objective of the financial system is to channel savings from investors to those who need funding. Credit can be channeled directly from the lender to the borrower (direct finance) or alternatively through the banking system (indirect finance). Traditionally, banks take deposits from households (savers) and lend out to borrowers such as other households or firms. Generally, bank lending is perceived to be an important factor supporting economic growth. For example, bank credit is used to finance investment, working capital and important components of consumption, thereby supporting economic activity (Abiad, Li, & Dell'Ariccia, 2011). Hence, disruptions in financial intermediation, i.e. in credit supply, may have adverse impacts on economic activity. For instance, Claessens and Kose (2013) point out that falling market price of collateral leads to the inability of firms to use assets as a collateral for new loans and weakens banks' ability to extend new credit in case that borrowing or lending is collateralized. This, in turn, is likely to hinder investments and therefore economic activity (Claessens & Kose,

2013).

During the last decade, the role of credit in shaping economic recoveries has been the subject of growing body of literature (see e.g. Abiad et al., 2011; Bijsterbosch & Dahlhaus, 2015; Coricelli & Frigerio, 2015). In particular, a phenomenon called creditless recovery — an episode in which GDP recovers relatively quickly to pre-crisis level without recovery in the stock of credit — has been studied in more detail in recent years. Several studies have shown that creditless recoveries are not rare events, since about one out of five recoveries can be classified as creditless (see e.g. Bijsterbosch & Dahlhaus, 2015; Sugawara & Zalduendo, 2013). Importantly, creditless recoveries tend to be weaker and more protracted when compared to "normal" recoveries (see e.g. Abiad et al., 2011; Bijsterbosch & Dahlhaus, 2015). For this reason, more and more attention should be devoted to the study of this phenomenon.

Consequently, the aim of this thesis is to answer two questions. First, what are the main determinants of creditless recoveries in advanced economies? Second, are there any differences in the determinants of creditless recoveries between (i) advanced and (ii) emerging and developing economies? These questions are analyzed using a panel probit estimation method and an unbalanced data sample including 32 advanced and 105 emerging and developing countries in the period of 1980–2015.

Why is it important to study creditless recoveries in advanced economies in more detail? Understanding factors that typically precede creditless recoveries is crucial for improving our understanding of an economic outlook after a financial crisis or in circumstances when bank lending is constrained (Bijsterbosch & Dahlhaus, 2015). In contrast to the study of Bijsterbosch and Dahlhaus (2015) that focuses only on emerging markets, my goal is to shed light on the challenges faced in advanced economies in the aftermath of recessions. Previous studies have focused more on emerging economies, but the global financial crisis of 2007–2009 has at the latest shown that advanced economies cannot be excluded from investigations. Since the existing

literature suggests that creditless recoveries are unfavourable compared to "normal" recoveries from an economical point of view, a more detailed examination of the phenomenon is needed in order to improve our understanding of the nature and causes of creditless recoveries. Furthermore, I believe it is important to explore whether discrepancies in the determinants of creditless recoveries arise between the country groups. If the main factors behind the phenomenon of creditless recovery differ between the country groups, also optimal policy measures aimed at preventing financial crises or mitigating their effects would be likely to differ as well.

The rest of this thesis is organized as follows. Section 2 reviews the existing literature related to the relationship between bank credit and economic recovery, focusing mainly on creditless recoveries. Section 3 identifies creditless recoveries and describes the data that is used in the empirical part of this thesis. In addition, some descriptive statistics arising from the data are presented. Section 4 introduces the empirical methodology. Section 5 presents the empirical results and explores the robustness of the findings. Section 6 discusses the results in more detail. Finally, section 7 concludes.

2 Literature review

This section begins by a brief introduction and discussion of the theoretical framework and the link between macroeconomic and financial variables, such as output and credit growth. Next, the focus will be shifted purely to the phenomenon of creditless recovery and related literature. Finally, some underlying hypotheses that may explain the occurrence of creditless recoveries presented in the previous literature are summarized.

2.1 Relationship between credit and economic recovery

Bank credit is widely recognized as an important source of finance. For instance, it allows investment, working capital and important components of consumption to be financed, thereby supporting economic activity (Abiad et al., 2011). The global financial crisis of 2007–2009 hit many countries all around the world and drove several advanced, emerging and developing countries into recessions. In the wake of the global financial crisis, many of these countries experienced severe financial disruptions, such as deep contractions in the supply of credit and sharp falls in asset prices (Claessens, Kose, & Terrones, 2012).

The links between macroeconomic and financial variables, such as output and credit over the business cycle, are comprehensively explored in many previous studies (see e.g. Claessens et al., 2012; Kannan, 2012; Takáts & Upper, 2013). According to Helbling, Huidrom, Kose, and Otrok (2011), basic economic theory suggests that wealth and substitution effects enable macroeconomic and financial variables to interact closely under complete markets with no financial imperfections. For example, households' consumption and eventually wealth may be affected by movements in credit and asset prices. Moreover, movements in asset prices also affect firms' net worth and the market value of the capital stock relative to its replacement value, thereby

having an impact on investments. However, there is no role for financial intermediaries[1] or credit market disruptions in models of complete markets due to the assumption that financial market imperfections do not exist. Hence, credit shocks can play only a minor role in explaining business cycles under complete markets. (Helbling et al., 2011.)

In reality, financial market imperfections obviously exist. Financial imperfections enable the amplification of interactions between financial variables and the real economy through the financial accelerator[2] and related mechanisms. The amplification occurs mainly through households, firms and countries' balance sheets. For instance, an increase in asset prices will in turn increase firms' net worth and therefore improve its capacity to borrow, invest and consume. Increased economic activity may further increase asset prices, strengthen firms' balance sheets and, thus, amplify shocks to the real economy (see e.g. Bernanke & Gertler, 1989; Bernanke, Gertler, & Gilchrist, 1999; Kiyotaki & Moore, 1997). In case of falling asset prices, the situation is reversed. Overall, the real economy is more prone to larger cyclical fluctuations due to credit market imperfections. (Helbling et al., 2011.)

Claessens et al. (2012) examined the interaction between business and financial cycles both in advanced and emerging economies by analyzing the behavior of major macroeconomic and financial variables. In particular, their main interest was to explore *"how does the nature of business cycles vary across different phases of the financial cycles"*. Their analysis leads to three major findings. First, the interaction between business and financial cycles is

[1] In this thesis, financial intermediaries are defined as deposit banks. Non-bank financial institutions, such as insurance institutions or credit card companies, have not been taken into account as financial intermediaries because of the fact that credit data includes only credit extended by banks.

[2] *"The term financial accelerator is used for the economic shocks amplification and propagation mechanisms, which aims to explain how relatively small economic shocks can have large and persistent effects on aggregate economic activity due to financial market imperfections" (Ćorić, 2011).*

crucial in explaining and shaping economic recessions and recoveries. Especially financial disruptions such as house and equity price busts tend to lead into longer and deeper recessions. They also argue that recoveries tend to be weaker if they are preceded by asset price busts, while rapid growth in credit and house prices may contribute to faster economic recovery. Second, they compare financial and business cycles and find that financial cycles tend to be longer, deeper and sharper than business cycles. Third, they argue that emerging markets tend to face more pronounced business and financial cycles compared to those in advanced economies. (Claessens et al., 2012.)

2.2 Creditless recoveries

According to the brief outline of the previous section, it should be expected that in reality, business and financial cycles should virtually move in the same direction. More specifically, credit and national GDP should follow each other due to the financial accelerator and related mechanisms based on the fact that financial market imperfections exist in the real world. However, the evidence shows that this is not always true.

During the last ten years, a growing body of literature has examined the link between economic recovery and credit growth. The recent literature has shown that an economy may be able to recover without the help of credit in the aftermath of recessions or financial crises. The phenomenon of creditless recoveries was first presented by Calvo, Izquierdo, and Talvi (2006a). In their seminal paper they studied the behavior of output and credit growth after systemic sudden stop episodes, i.e. after a situation when capital inflows fall sharply relative to their past trajectory. During systemic sudden stop episodes — which is a more common feature in emerging markets relative to advanced economies — the economy is usually exposed to rising international interest rates or outright exclusion from capital markets. In their paper, Calvo et al. (2006a) analyze output contractions that occurred in the context of a systemic sudden stop for the period of 1980–2004, focusing

on a sample of 31 emerging economies. They find that after an output contraction, the economy recovers relatively quickly — on average less than three years following an output trough — back to its pre-crisis levels, but with weak investment and virtually no recovery in external or domestic credit. This phenomenon is commonly known as the "Phoenix Miracle". (Calvo et al., 2006a.)

According to Calvo, Izquierdo, and Talvi (2006b), periods of systemic sudden stop episodes are suitable for investigating post-collapse recovery phases due to the facts that the shock is wide and easy to identify, it takes place in global markets and it affects many countries approximately at the same time. In the context of systemic sudden stop episodes, they investigate the development of several variables in emerging economies. Namely, these variables are total factor productivity, capital stock, investment, private sector bank credit and current account balance relative to GDP. Their findings indicate that bank credit and current account deficit collapse with output, but neither of these do not recover, at least not to the same extent as output. Moreover, they argue that the development of total factor productivity follows closely output development, whereas capital or employment levels are not reacting substantially during systemic sudden stop episodes. Lastly, they find a remarkable drop in investment as a share of GDP in the context of systemic sudden stop episodes that fails to recover to the same extent than output. (Calvo et al., 2006b.)

Abiad et al. (2011) analyze in detail the characteristics of recoveries including 48 countries from emerging and advanced economies for the period of 1964–2004. They find that creditless recoveries represent about one-fifth of all recoveries, but the difference between (i) advanced and (ii) emerging economies is prominent. They show that in advanced economies only one-tenth of recoveries take place without positive real credit growth. In addition, their findings indicate that creditless recoveries tend to be weaker and more persistent compared to normal recoveries, and output growth is, on average,

a third lower when the recovery is creditless. Their findings also demonstrate that the frequency of creditless recoveries increases substantially if recessions were preceded by a credit boom or banking crisis. Furthermore, Abiad et al. (2011) argue that the occurrence of a creditless recovery is very likely to happen if the recession was preceded by the combination of a credit boom and a banking crisis. However, the impact of currency or sovereign debt crises are shown to be substantially smaller. They also find that the contribution of investment to output growth decreases by roughly half during creditless recoveries compared to normal recoveries, whereas the corresponding fall in consumption is about a third. This indicates that the difference in output growth rates between creditless and normal recoveries depends more on investment that is perceived to be more dependent on bank credit compared to consumption. Overall, the findings from both macro and industry-level data suggest that the constrained growth due to impaired financial intermediation is the main reason for weak macroeconomic performance during creditless recoveries. (Abiad et al., 2011.)

Bijsterbosch and Dahlhaus (2015) and Sugawara and Zalduendo (2013) analyze the determinants of creditless recoveries by using a probit model, the former focusing on 86 emerging and developing economies and the latter also on advanced economies (96 countries totally). Sugawara and Zalduendo (2013) find that more than 25 percent of all recoveries have been creditless in the period of 1965–2011, when all country groups are included in the sample. They also show that around 45 percent of all creditless recoveries happened in 2009 and 2010, i.e. in the aftermath of the global financial crisis. Respectively, Bijsterbosch and Dahlhaus (2015) suggest that one out of four recoveries have been creditless in low- and middle-income countries in the period of 1970–2012, and output growth during the first year of a creditless recovery has been, on average, one-third lower than during normal recoveries. Bijsterbosch and Dahlhaus (2015) share the view of Abiad et al. (2011) that frequency of creditless recoveries at least doubles after a banking crisis, and

they also find that a currency crisis has the same level impact. In addition, Bijsterbosch and Dahlhaus (2015) find that large contractions in economic activity and financial stress typically preceded creditless recoveries, especially if countries suffered from high private sector indebtedness or if countries were dependent on foreign capital inflows. According to Sugawara and Zalduendo (2013), output and investment growth during creditless recoveries tend to be lower compared to normal recoveries. However, they find that the gap in growth rates tends to disappear by two years after the trough. They also argue that fiscal easing is likely to increase and monetary easing to decrease the probability of creditless recoveries. Further, Sugawara and Zalduendo (2013) find that trade openness decreases the likelihood of creditless recoveries.

Takáts and Upper (2013) focus mainly on two questions related to credit and output growth after financial crises. First, they ask whether the lower level of bank lending necessarily slow down economic recovery in the aftermath of a financial crisis even if the financial crisis was preceded by a credit boom. Second, they consider an issue of whether the impact of deleveraging in such a situation could be neutral or even beneficial for economic growth[3]. Their analysis includes 39 financial crises that were preceded by a private sector credit boom, country sample containing both advanced and emerging economies over the last 30 years. They find economic growth and the extent of bank credit to be uncorrelated during two first years of the recovery period, after which the correlation becomes statistically significant but remains negligible in economic terms. On the other hand, they find that real effective exchange rate and public debt significantly correlate with economic recovery, and especially real effective exchange rate may have a relatively strong influence on recovery. Takáts and Upper (2013) argue that their findings

[3]Bech, Gambacorta, and Kharroubi (2014) find that private sector deleveraging during a downturn associated with financial crises may have a positive effect on subsequent recoveries. However, their findings are somewhat tentative because of the limited data sample.

supplement the literature of creditless recoveries in the sense that deleveraging is not negatively associated with the economic recovery, if the financial crisis was preceded by a credit boom. They also find that the speed of recovery after financial crises preceded by a credit boom is uncorrelated with bank lending to the private sector. Therefore, the results are quite different when the focus is on financial crises which were preceded by credit booms compared to recoveries after recessions as defined e.g. by Abiad et al. (2011) or Bijsterbosch and Dahlhaus (2015). One possible reason for this difference might be the accumulated low quality debt during the credit boom prior to a financial crisis that may potentially be detrimental to economic growth (Takáts & Upper, 2013).

Kannan (2012) examines the interaction between financial crises and recessions, focusing purely on advanced economies. More specifically, the main idea of the paper is to analyze how stressed credit conditions, such as unusually high cost or restricted availability of credit, may contribute to the sluggishness of economic recovery in the aftermath of a financial crisis. The findings of the paper indicate that credit conditions are likely to influence on recoveries from recessions associated with financial crises. Furthermore, Kannan (2012) argues that several characteristics may cause industries to grow relatively slowly during recoveries from recessions associated with financial crises in an environment of stressed credit conditions. In particular, these characteristics comprise industries that are more dependent on external finance, have less assets eligible as loan collaterals or that consist of small size firms. Kannan (2012) also shows that the detrimental effects of stressed credit conditions tend to be strongest during the first year of the recovery, and after three years these effects will become negligible in economic terms.

Table 1 summarizes the main studies that have empirically investigated creditless recoveries. Based on the table 1, a few observations can be made. First, all of these studies have included emerging countries in their country sample, but none have concentrated purely on advanced economies. Further-

more, there are only a few studies that include the global financial crisis of 2007–2009 in their analysis. Second, a frequency analysis suggests that creditless recoveries tend to represent about 10%–25% of all recoveries, depending on the time period and country sample. Finally, all of these studies find that GDP growth appears to be faster during normal recoveries compared to creditless recoveries, regardless of the country sample or time period.

Table 1: Summary of creditless recovery literature

Study	**Country sample**	**Time period**	**Frequency**	**GDP growth**	
				Normal recoveries	Creditless recoveries
Abiad et al., 2011	48 advanced and emerging countries	1964–2004	All: 20% Advanced: 10%	6.3%	4.5%
Bijsterbosch and Dahlhaus, 2015	86 emerging and developing countries	1970–2012	25%	8.8%	6.1%
Darvas 2014	135 high-, middle- and low-income countries	1960–2006	All: 19.2% High: 12.8% Middle: 17.4% Low: 25.3%	All: 6.0% High: 4.1% Middle: 6.8% Low: 6.4%	All: 4.5% High: 3.2% Middle: 4.7% Low: 4.8%
Sugawara and Zalduendo, 2013	96 advanced, emerging and developing countries	1965–2011	over 25%	Advanced: 4.3% Emerging: 8.0%	Advanced: 2.8% Emerging: 5.0%

Note: GDP growth rates of Sugawara and Zalduendo are based on author's estimation from figures presented in the original paper.

2.3 Reasons behind creditless recoveries

This section specifies and summarizes several explanatory hypotheses associated with creditless recoveries made in previous literature, following the example of Coricelli and Frigerio (2015) and Darvas (2014) closely. Even though Calvo et al. (2006b) and Biggs, Mayer, and Pick (2009) have created brief analytical models in order to analyze creditless recoveries, Abiad et al. (2011) and Darvas (2014) argue that creditless recoveries are ambiguous from a theoretical perspective. Thus, the existing literature has focused more on explaining creditless recoveries through multiple hypotheses. Next, several different factors that may, at least to some extent, explain the occurrence of

creditless recoveries are introduced.

Calvo et al. (2006b) argue that creditless recoveries are highly suggestive of "sudden underutilization of capacity". They suggest that idle resources play an important role in rationalizing speedy recoveries after large contractions in output. As Calvo et al. (2006b) state in their paper, investments tend to recover more slowly in the wake of systemic crises when compared to output. This in turn indicates that firms could exploit unused capacity without investing. Since investments are generally assumed to be financed by bank credit (or are perceived as a credit-intensive activity), the lack of investment during a recovery phase is likely to restrict also bank lending, eventually leading to observations of creditless recoveries (Coricelli & Frigerio, 2015). In addition, Abiad et al. (2011) compare creditless and normal recoveries by decomposing aggregate growth into its demand components. They argue that the components of aggregate demand more dependent on credit contribute the most to the difference in growth rates between creditless and normal recoveries. Therefore, since investments are perceived to be more dependent on credit than consumption, investment contributes less to output growth during creditless recoveries compared to normal recoveries.

Calvo et al. (2006b) also argue that drastically increased interest rates may contribute to the emergence of a "liquidity crunch" that will possibly lead to a collapse of output. In that case, liquidity can be restored in various ways, one of which is a discontinuation of investment projects. If firms decide to curtail investments and therefore borrowing, it should be possible to boost liquidity and eventually output. However, as Calvo et al. (2006b) argue, lowering the rate of investment is just one way to restore liquidity and there should be more detailed microeconomic data and further analysis to research this issue.

In contrast to Calvo et al. (2006a, 2006b) who define creditless recoveries as situations where output returns relatively quickly to pre-crisis level with-

out recovery in the stock of credit[4], Biggs et al. (2009) argue that it is the change in the flow of credit[5] rather than the stock of credit that matters more for economic recovery. Hence, their argument is that the use of an incorrect choice of the relevant credit variable may influence the existence of creditless recoveries. Biggs et al. (2009) use data from emerging and advanced economies and argue that the economy is able to rebound after a financial crisis if the flow of credit would increase, which is possible even when the stock of credit continues to decline. For example, if credit growth falls, both the stock and the flow of credit would decline, which implies that also output growth would decrease. As credit growth stabilizes at a lower level, the flow of credit will begin to rebound, which in turn may help output to recover. Hence, credit growth itself does not necessarily have to be positive. Biggs et al. (2009) argue that the development in the flow of credit is more important for understanding large fluctuations in output. However, the distinction between the stock and the flow of credit is overly simplistic and, therefore, Biggs et al. (2009) point out that their arguments should not be understood as saying that the stock of credit is not important for output. Coricelli and Frigerio (2015) compare empirically "Calvo type" and "Biggs type" creditless recoveries and find that neither of these are rare events, but their results highlight one important difference between the two. Precisely, "Calvo type" creditless recoveries are associated with relatively larger contractions in GDP per capita during the recession phase compared to "Biggs type" creditless recoveries (Coricelli & Frigerio, 2015).

Darvas (2014) suggests that real exchange rate depreciation may be one explanatory variable that could shed some light on creditless recoveries, since exporting companies may have better access to finance due to increased trade revenue. However, the causality of the relationship is unclear, since GDP

[4]The stock of credit is defined as the total amount of outstanding credit of the non-financial sector.

[5]The flow of credit is defined as the amount of new net credit extended out over a certain period (i.e. the flow is equal to the change in the stock).

growth, credit growth and the real exchange rate are all endogenous variables and there is no well identified formal model to verify that the real exchange rate depreciation would cause output to recover when credit is not growing. Nonetheless, the stylized fact presented by Darvas (2014) suggests that GDP growth may be tricky in the absence of sizeable real exchange rate depreciation, if credit growth is not recovering. (Darvas, 2014.)

Claessens, Kose, and Terrones (2009a, 2009b), Coricelli and Frigerio (2015) and Abiad et al. (2011) suggest that alternative sources of financing may replace bank credit during recoveries from recessions associated with credit crunches and asset price busts. This, in turn, may lead to an observation of creditless recoveries in cases when credit is measured as bank credit. For instance, firms and households may substitute bank credit with trade credit[6] or internal finance. However, Abiad et al. (2011) argue that some of the alternative funding sources can be more expensive for firms and households, which in turn may lead to a certain degree of inefficiency. Coricelli and Frigerio (2015) find industry-level evidence that output performance during the peak-to-recovery period is positively associated with lower dependence of bank credit relative to trade credit, especially when the recovery is creditless. On the contrary, Coricelli and Frigerio (2015) argue that a stronger dependence on trade credit relative to bank credit would have a negative impact on output growth during recoveries at the country level. This may be due to the fact that trade credit chains affect the existence of a propagation of financial distress during crisis episodes (Coricelli & Frigerio, 2015). However, Coricelli and Frigerio (2015) point out that these results only apply to emerging, but not in advanced economies. They argue that one possible explanation behind the difference between emerging and advanced economies is that the

[6] An agreement that allows a customer to purchase goods on account (without immediate payment), paying the supplier at a later day. Trade credit is commonly used by firms as a source of short-term financing, which is granted to customers that are financially sound and goodwill.

higher level of development of financial markets in advanced countries makes it easier for industries dependent on external finance to exploit other sources of financing, such as corporate bonds and equity and therefore recover better. Importantly, it should be noted that the sample of Coricelli and Frigerio (2015) excludes the Great recession of 2007–2009. Since the financial shock during the Great recession affected all segments of financial markets, it is likely that the performance of advanced economies were much closer to that of emerging economies.

Finally, the argument that creditless recoveries may be associated with a switch from more to less credit-intensive sectors in such a way that credit does not expand is made several times in previous literature (see e.g. Abiad et al., 2011; Claessens et al., 2009a, 2009b; Coricelli & Frigerio, 2015). The findings of Abiad et al. (2011) from sectoral data are consistent with the fact that firms or households may delay or downsize their more credit dependent investment and expenditure decisions. Creditless recoveries may be inefficient compared to normal recoveries due to the probable lower long-run growth, which may be explained by the shift away from more to less credit intensive activities as less credit-intensive activities may be characterized by slower growth of productivity (Coricelli & Frigerio, 2015). Abiad et al. (2011) argue that less credit-dependent sectors may benefit from the lack of credit, which in turn may lead to a suboptimal composition of output growth. If banks are cutting their lending to certain sectors but extending it to others, it is possible that output may expand even though the aggregate credit growth is negative, as long as the most productive sectors or firms are receiving the credit (Abiad et al., 2011).

Table 2: Why do we observe creditless recoveries?

Study	**Hypothesis**	**Explanation**
Abiad et al. (2011), Claessens et al. (2009a, 2009b), Coricelli and Frigerio (2015)	Alternative sources of finance	Alternative sources of finance, such as trade credit or internal finance, may replace bank credit during recoveries.
Abiad et al. (2011), Claessens et al. (2009a, 2009b), Coricelli and Frigerio (2015)	Switch from more to less credit-intensive sectors	Firms and household may be forced to delay or downsize their investment and expenditure decisions that are more dependent on bank credit and focus more on activities that are less dependent on bank credit.
Biggs et al. (2009)	Incorrect choice of credit variable	The development of the flow of credit should be used instead of the stock of credit. If credit falls rapidly in the trough year but then stabilizes in the year following the trough, the change in credit growth is positive (even though the stock of credit may be negative) and that may help an economy to recover.
Calvo et al. (2006b)	Underutilization of capacity	After recessions firms exploit unused capacity without new investments, that typically depend strongly on bank credit.
Calvo et al. (2006b)	Liquidity crunch	Firms restore their liquidity by discontinuing their investment projects and borrowing, which in turn may boost output growth.
Darvas (2014)	Real exchange rate depreciation	Real exchange rate depreciation may help exporting firms to get finance because of their increased trade revenues.

Note: Credit is assumed to cover only credit extended by banks.

Table 2 summarizes the main hypotheses made in previous literature and briefly explains why these hypotheses may lead to an observation of a creditless recoveries. Importantly, it must be noted that these studies assume that the term "credit" means credit that is extended only by banks, which is also assumed throughout this thesis.

3 Data

This section starts by identifying a creditless recovery dummy variable that is used as a dependent variable in the empirical analysis. Then, the data used in this thesis is described in more detail. Finally, the country-specific stylized facts related to creditless recoveries are presented.

3.1 Identifying creditless recoveries

To be able to identify creditless recoveries, it is necessary to determine two distinct phases; (i) how to define a recession and (ii) how to define a recovery. First, economic downturns are identified following the methodology of Braun and Larrain (2005), in which recessions are identified from the fluctuations of real annual GDP. More specifically, recessions are identified as years when cyclical GDP is more than one country-specific standard deviation below zero. Cyclical GDP can be calculated by subtracting a trend computed by the Hodrick-Prescott filter[7] (HP-filter) from the logarithm of real GDP. Therefore, the recession is dated as starting in the year following the previous peak of cyclical GDP, and ending in the year of the trough.

The HP-filter has been widely used in applied econometric work to detrend data in recent decades. In particular, it is used as a tool to assist the measurement of business cycles. For instance, the HP-filter is usually used to produce new time series such as potential GDP and the output gap in economic literature. However, the use of the HP-filter has faced a lot of criticism in public debate (see e.g. Krugman, 2012). As Phillips and Jin (2015) point out, one concern of the two-sided HP-filter is that it averages data ahead and before each data point. In fact, Phillips and Jin (2015) argue that the interpretation of a new series produced by an HP-filter as a trend is not straightforward, because the new series only demonstrates a general course

[7]As recommended by Ravn and Uhlig (2002), the smoothing parameter is set at 6.25 for annual data.

of the observed data after graduating out fluctuations. Furthermore, they state that this graduation depends on the choice of the smoothing parameter, which is supposed to represent the underlying trend. Hamilton (2016) argues that time series produced by HP-filter may be spurious dynamic relations that are only artifacts of the HP-filter and do not reflect the underlying data-generating process. In addition, Darvas (2014) suggests that another problem of the HP-filter is that the filtered end-of-sample values are typically more doubtful due to the fact that adding new observations may cause the estimated trend and cyclical components for the last few observations to change significantly.

The next step is to identify the recovery period. By following the method of Abiad et al. (2011), the post-recession recovery period is defined as the first three years following the trough of cyclical GDP. In other words, if the trough year is defined as t, then the onset of a recovery period is defined as the period following the trough, i.e. $t + 1$.

Finally, the identification of creditless recoveries follows the concept of Bijsterbosch and Dahlhaus (2015), where they construct six different definitions of creditless recoveries. However, two of these definitions are left out because of the relative rigidity[8]. Hence, the chosen definitions that are used in this thesis are shown in table 3 below.

[8]These definitions are (i) "3 years of consecutive negative annual real credit growth after the trough" and (ii) "2 years of consecutive negative annual real credit growth after the trough".

Table 3: Definitions of creditless recoveries

Number	Definition
1	Negative average real credit growth for the 3 years following the trough
2	Negative average real credit growth for the 2 years following the trough
3	Level of real credit is higher in the trough year (t) than in $t+3$
4	Level of real credit is higher in the trough year (t) than in $t+2$

Source: Bijsterbosch and Dahlhaus (2015).

3.2 Data description

This thesis uses country-level data on annual basis. In principle, the sample includes 35 advanced and 142 emerging and developing economies, but as shown later, several countries must be excluded from the empirical analysis because of data limitations in explanatory variables. The country classification is based on IMFs World Economic Outlook database (October 2016)[9]. The chosen period is 1980-2015 because of the adequate data availability. However, data availability varies substantially within this period among the countries. In order to be able to construct the dependent creditless recovery dummy variable, two variables are needed: the real GDP and credit to private sector. The real GDP data is taken from the IMFs International Financial Statistics (IFS), IMFs World Economic Outlook (WEO) or OECD National Accounts Statistics in national currencies[10]. Credit to private sector[11] data is from IFS in national currencies. However, for the countries that adopted the euro, the credit data is converted into euros by using IMFs World Economic Outlook's fixed conversion rates. In addition, credit to the private sector is converted into a real indicator by using a GDP deflator taken from World

[9]See Table A1 in Appendix.

[10]In OECD National Accounts Statistics, the real GDP data is converted into euros since 1980 for countries that have adopted euros.

[11]Credit series in IFS database covers credit extended by banks only. Therefore, non-bank financial intermediaries are excluded from the discussions.

Banks World Development Indicators (WDI) database.

In the empirical part of this thesis, which will closely mimic Bijsterbosch and Dahlhaus (2015), the aim is to examine the determinants of creditless recoveries both in (i) advanced and (ii) emerging and developing economies. Based on the example of Bijsterbosch and Dahlhaus (2015), the following variables are selected as explanatory variables[12]; real GDP growth, credit-to-GDP ratio, banking crisis dummy, currency crisis dummy, current account balance ratio to GDP, investment growth and export growth. Banking and currency crisis dummies are taken from Laeven and Valencia (2012) systemic banking crises database, whereas current account balance is taken from WEO (October 2016) database. In addition, investment and export data are available in IFS database. A more detailed description of data sources is presented in Data Appendix.

The intuition behind the data selection is that financial frictions play a key role during a recovery phase. Hence, the selected explanatory variables can be divided into two parts. First part of the variables contains information about the behaviour of output during a recovery period. Second part of the variables gives signals of the process of financial intermediation or a high degree of leverage. (Bijsterbosch & Dahlhaus, 2015.)

The dependent variable in the analysis determines whether the recovery is creditless or not. The selection of explanatory variables includes a total of seven variables, and all of these are lagged by one year because of the possible endogeneity problems. The justification of the selection of these variables is based entirely on Bijsterbosch and Dahlhaus (2015) that are presented below in more detail:

1. **Real GDP growth** — The assumption is that the deeper the preceding contraction of real GDP, the larger the probability that output will recover without credit growth. As pointed out in Calvo et al.

[12]I would like to thank Martin Bijsterbosch and Tatjana Dahlhaus for kindly sharing their data with me.

(2006b), investment appears to recover much more slowly than output after systemic crises. This in turn indicates that instead of investing in (and borrowing for) new production, output recovery takes place mainly through the absorption of unused capacity.

2. **Credit-to-GDP ratio** — A high private sector credit-to-GDP ratio indicates that the private sector of an economy is more indebted and hence, there might be need for private sector deleveraging (i.e. reducing the private sector debt level), especially after a contraction in output. Therefore, a high level of credit-to-GDP ratio may indicate that it is more likely that the recovery phase will be creditless as firms may not be willing to take new credit from banks. In addition, a rapid increase in credit-to-GDP ratio in the preceding years may also indicate that a credit boom took place, and therefore banks may be more cautious to grant new loans.

3. **Banking crisis dummy** — Banking crisis dummy contains information about financial tensions. A banking crisis typically leads to a situation where banks start to clean up their balance sheets and therefore reduce lending. That period usually lasts at least for a couple of years, so it is assumed that creditless recoveries are more likely if the economic downturn is preceded by a banking crisis.

4. **Currency crisis dummy** — The choice of this variable is based on the same arguments as the banking crisis dummy above. A currency crisis may lead to a reduction of investments from abroad. This is more likely to happen and thereby affect financial intermediation in emerging and developing economies, since the financial markets tend to be less developed compared to advanced economies. Currency crisis are often associated with disruptions in capital flows, which further according to Calvo et al. (2006a), are closely associated with creditless recoveries.

5. **Current account balance (% of GDP)** — The current account balance variable contains information about an economy's health. If an economy is facing a high current account deficit, it is typically more dependent on foreign capital inflows, which are often used to finance the domestic banking system and domestic spending especially in emerging and developing markets. Besides this, a high current account deficit may indicate an unsustainable credit boom. Therefore, it is assumed that the higher current account deficit (i.e. the lower the current account balance-to-GDP ratio) will increase the probability of creditless recoveries.

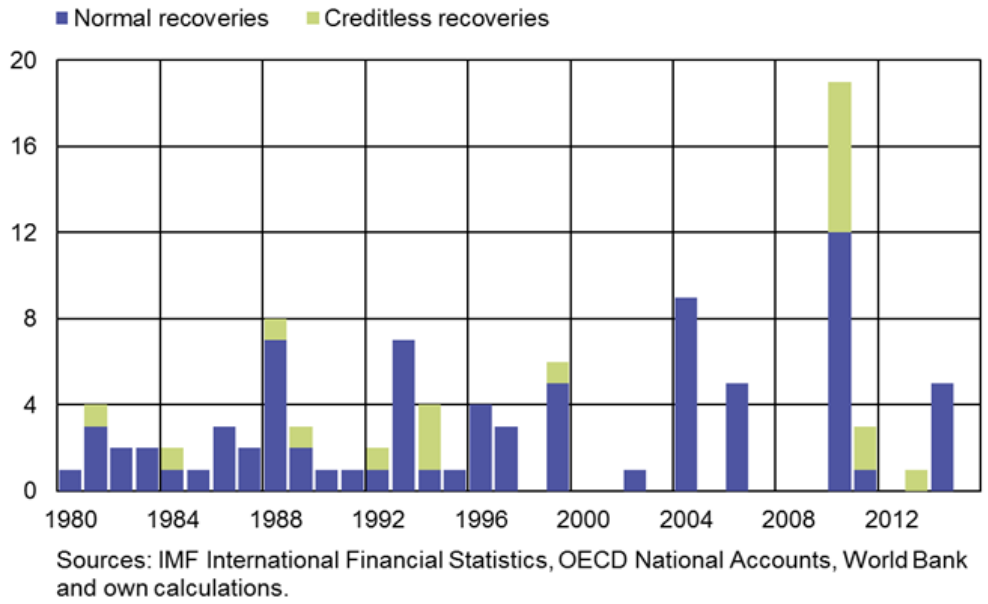
6. **Investment growth** — According to Calvo et al. (2006b), a liquidity crunch may occur due to a sharp increase in interest rates. However, liquidity can be restored, for example, through discontinuation of investment projects. If firms decide to curtail investments and therefore borrowing, it is possible to boost liquidity and eventually output. The investment growth variable tries to capture this effect. Hence, it is assumed that a decline in investment growth would be positively associated with the occurrence of creditless recoveries.

7. **Export growth** — If credit-intensive domestic expenditure components remain subdued as a result of the recession, the export growth variable may have a key role in boosting the economy to recover.

3.3 Stylized facts

This section introduces some stylized facts of creditless recoveries that are based on publicly available data sources and have been collected by the author. Figure 1 illustrates the frequency of recovery episodes in advanced economies between 1980 and 2015. Respectively, figure 2 shows the corresponding situation in emerging and developing economies. As can be seen,

Figure 1: Number of recovery episodes in advanced economies, 1980–2015



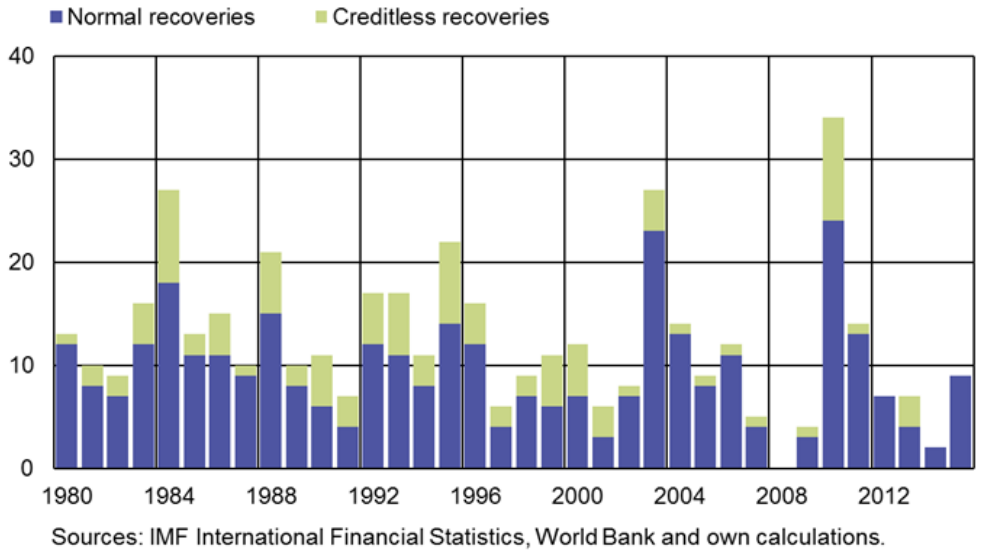
creditless recoveries, defined according to definition 3[13] in table 3, are not rare in either of the country groups. For advanced economies, the sample includes 100 recovery episodes, of which 19 can be defined as creditless[14]. Therefore, 19% of all recoveries have been creditless in advanced economies during the period of 1980–2015. In light of the earlier literature, this finding is abnormal. For instance, Abiad et al. (2011) suggest that only about 10% of all recoveries are creditless in advanced economies. However, their data does not cover the recent global financial crisis, which appears to be strongly associated with creditless recoveries. Since seven of the nineteen creditless recoveries started in 2010, it can be concluded that the global financial crisis has been an exceptional event in advanced economies in this context (almost

[13]This definition is used both in Abiad et al. (2011) and Bijsterbosch and Dahlhaus (2015).

[14]See Table A2 in Appendix.

37% of total creditless recoveries occurred in 2010). Figure 1 also shows that creditless recoveries tend to occur only occasionally in the sample of advanced economies. In addition, the number of recovery episodes declines from 100 to 83 if recoveries for which credit data is not available would be excluded. This means that 23% of recoveries would be creditless.

Figure 2: Number of recovery episodes in emerging and developing economies, 1980–2015



For emerging and developing economies, the sample contains 449 recovery episodes, of which 113 are defined as creditless[15]. Hence, roughly every fourth recovery is classified as creditless in emerging and developing countries. Again, excluding recoveries for which credit data is not available reduces the total number of recovery episodes from 449 to 394, indicating that 29% of recoveries are defined as creditless. This is well in line with the findings of previous studies[16]. Moreover, creditless recoveries occur almost every year

[15]See Table A3 in Appendix.

[16]See e.g. Bijsterbosch and Dahlhaus (2015), Sugawara and Zalduendo (2013).

in the sample of emerging and developing economies, but there seems to be clear "peak years", when the number of creditless recoveries is relatively higher than otherwise. Such periods are, for example, the early 1980s following the Latin American debt crisis or 2010, when many countries started to recover from the global financial crisis.

Overall, it can be concluded that the global financial crisis of 2007–2009 is the most important event associated with creditless recoveries in both country groups during the last 35 years. In particular, its relevance has been prominent for advanced economies.

Average annual real GDP growth rates in advanced economies during the first 3 years of normal and creditless recoveries are shown in table 4. The findings suggest that creditless recoveries are associated with slower GDP growth rates compared to normal recoveries. Average output growth is 8.80 % in the first year of creditless recovery, whereas it is a bit higher (9.39 %) in the first year of a normal recovery. Therefore, output growth tends to be slightly weaker during creditless recoveries than during normal recoveries[17]. Furthermore, standard deviations indicate larger amount of variation in growth rates across advanced countries during the first year of recovery compared to the second or third year both in terms of normal and creditless recoveries.

Table 4: Average annual real GDP growth during the first 3 years of recoveries in advanced economies

Advanced economies	1st year		2nd year		3rd year	
Normal recoveries	9.37%	(0.116)	7.64%	(0.050)	6.31%	(0.077)
Creditless recoveries	8.80%	(0.087)	7.12%	(0.062)	5.32%	(0.050)

Standard deviations in parentheses.

Source: Author's calculations.

[17]Recoveries in Iceland (1981), Israel (1989, 1994), Malta (1990) and Macao SAR (2002) have been left out from calculations because of the data ambiguity.

Table 5: Average annual real GDP growth during the first 3 years of recoveries in emerging and developing economies

Emerging and developing economies	1st year		2nd year		3rd year	
Normal recoveries	8.84%	(0.103)	6.74%	(0.093)	5.46%	(0.050)
Creditless recoveries	6.33%	(0.081)	4.57%	(0.055)	3.95%	(0.058)

Standard deviations in parentheses.

Source: Author's calculations.

Respectively, table 5 illustrates average annual real GDP growth rates in emerging and developing economies during the first 3 years of normal and creditless recoveries. The findings are somewhat similar to those in advanced economies, albeit the difference in GDP growth rates between normal and creditless recoveries seems to be slightly higher. Similarly, standard deviations reflect larger variation in the first year of normal and creditless recovery in GDP growth rates also in emerging and developing countries. When comparing GDP growth rates in the second and third years between the country groups, it can be observed that advanced economies achieve, on average, higher growth rates during normal and creditless recoveries than emerging and developing countries. This may indicate that more developed financial markets play a key role in boosting the economy to recover faster in the aftermath of recessions. Moreover, the findings of emerging and developing economies are well congruent with those made by Bijsterbosch and Dahlhaus (2015).

4 Methodology

This section introduces the panel probit model that is used for estimating and investigating the determinants of creditless recoveries in (i) advanced and (ii) emerging and developing economies during 1980-2015. Moreover, this section introduces a (i) pooled panel probit and a (ii) random effects panel probit model that are used in the estimation procedure. Next, the usual estimation method of a probit model, maximum likelihood, is introduced. Finally, the purpose and the formal design of marginal effects are presented to be able to understand and analyze the estimation results in more detail.

4.1 Probit model

The following introduction of the probit model relies heavily on Verbeek (2012). Binary choice models, such as probit and logit models, are used to model the choice between two binary outcome variables. In this thesis, the choice is whether the following recovery phase after a recession is creditless or not. In empirical literature, the probit model is frequently used in analysing issues such as financial crises (see e.g. Berg & Pattillo, 1999; Canova, 1994; Falcetti & Tudela, 2006; Kamin, Schindler, & Samuel, 2007) and current account reversals (see e.g. Liesenfeld, Valle Moura, & Richard, 2010; Milesi-Ferretti & Razin, 1998). In order to motivate the use of the probit model in this context, it is necessary to briefly show why the basic linear regression is not suitable for estimating the determinants of creditless recoveries.

Let's assume that a binary variable y_i is defined as follows:

$$\begin{cases} y_i = 1, & \text{if creditless recovery} \\ y_i = 0, & \text{otherwise.} \end{cases} \tag{1}$$

If the linear regression model would be used, the model would be given by

$$y_i = \beta_1 + \beta_2 x_{i2} + \varepsilon_i = x_i'\beta + \varepsilon_i, \tag{2}$$

where $x_i = (x_{i1}, x_{i2})'$. Furthermore, the standard assumption implies that $E\{\varepsilon_i|x_i\} = 0$ and $E\{y_i|x_i\} = x_i'\beta$. Hence,

$$\begin{aligned} E\left\{y_i|x_i\right\} &= 1 * Pr\left\{y_i = 1|x_i\right\} + 0 * Pr\left\{y_i = 0|x_i\right\} \\ &= Pr\left\{y_i = 1|x_i\right\} = x_i'\beta. \end{aligned} \tag{3}$$

The previous equation states that $x_i'\beta$ is a probability, indicating that it should always take values between 0 and 1. In practice this is challenging to achieve since the only possibility is that the x_i values are bounded and β must satisfy certain restrictions. Another problem arises since the error term has a non-normal distribution and suffers from heteroskedasticity. Consequently, binary choice models will be used in the estimation procedure in order to overcome these problems associated with linear regression. (Verbeek, 2012.)

The probit or logit models describe directly the probability that the dependent variable $y_i = 1$. Formally, the binary choice model can be described as

$$Pr\left\{y_i = 1|x_i\right\} = F(x_i, \beta), \tag{4}$$

where the probability of having $y_i = 1$ depends on the vector x_i that contains the chosen explanatory variables[18]. The function $F(\cdot)$ takes values in the interval $[0, 1]$ only. Furthermore, $F(\cdot)$ is chosen to be some distribution function. In the probit model, this is the standard normal cumulative distribution function[19], interpreted as follows:

$$F(x\beta) = \Phi(x\beta) = \int_{-\infty}^{x\beta} \frac{1}{\sqrt{2\pi}} exp\left\{-\frac{1}{2}t^2\right\} dt, \tag{5}$$

where $\frac{1}{\sqrt{2\pi}} exp\left\{-\frac{1}{2}t^2\right\}$ is the standard normal density. Typically, the results between probit and logit models are very similar with each other. (Verbeek, 2012.)

[18]In this thesis, the probability of a creditless recovery depends on real GDP growth, credit-to-GDP ratio, banking crisis, currency crisis, current account balance ratio to GDP, investment growth and export growth.

[19]In the logit model, this is the standard logistic distribution function.

4.1.1 Pooled panel probit model

By following the study of Bijsterbosch and Dahlhaus (2015), the baseline specification in this thesis is a static panel probit model,

$$y_{it}^* = x_{it}'\beta + \varepsilon_{it}, \qquad \varepsilon_{it} \sim iidN(0,1) \tag{6}$$

$$y_{it} = I(y_{it}^* > 0), \qquad i = 1, ..., N, \quad t = 1, ..., T, \tag{7}$$

where the binary variable y_{it} is observed by means of an indicator function $I(y_{it}^*)$. The binary variable y_{it} is observed to take on a value of 1 if the unobserved variable y_{it}^*[20] is greater than 0. Otherwise, the binary variable $y_{it} = 0$. In this thesis, the observed variable y_{it} represents the onset of a creditless recovery in country i at time t. Hence, a creditless recovery is observed (i.e. $y_{it} = 1$ during the first year of creditless recovery) if and only if $y_{it}^* > 0$. In this thesis, creditless recoveries are defined according to definition 3[21] in table 3, but the other definitions are also used later for assessing the robustness of the results. The vector x_{it}' contains observed explanatory variables which might affect the probabilities of occurrences of creditless recoveries. The assumption of the probit model is that the error term ε_{it} contains unobserved characteristics and is normally distributed with zero mean and fixed variance. (Bijsterbosch and Dahlhaus, 2015.)

4.1.2 Random effects panel probit model

According to Bijsterbosch and Dahlhaus (2015), the error term is assumed to be independent across time and countries in the pooled version of a panel probit model. However, they state that a pooled panel probit model is rather restrictive as it ignores possible serial dependence and unobserved heterogeneity. Therefore, also the random effects probit model, which was proposed by Butler and Moffitt (1982), is used in the estimation as it allows to take

[20] Also called "latent variable".

[21] The level of real credit in trough year t is higher than in $t + 3$.

the unobserved time-invariant heterogeneity across countries into account. The error term in the random effects probit model is given by

$$\varepsilon_{it} = \alpha_i + e_{it}, \qquad e_{it} \sim iidN(0,1), \quad \alpha_i \sim iidN(0, \sigma_\alpha^2), \tag{8}$$

where α_i represents the time-invariant country-specific effect that implies a constant cross-period correlation of ε_{it}, given by $\rho = \frac{\sigma_\alpha^2}{\sigma_\alpha^2+1}$ (Greene, 2003).

4.2 Maximum likelihood estimation

The usual estimation method of a probit model is maximum likelihood. According to Verbeek (2012), the maximum likelihood estimation method relies on the assumption that we know the distribution of an observed phenomenon, but we do not have to worry about the distribution of an unknown parameter vector. The idea of the maximum likelihood method is to estimate these unknown parameters by taking those values that give the highest likelihood for the observed values. The strength of the maximum likelihood estimation method is that it typically gives a consistent and asymptotically efficient estimator with an asymptotic normal distribution. On the other hand, it must be noted that these conditions are only valid if certain distributional assumptions are satisfied. (Verbeek, 2012.)

Generally, the likelihood function can be interpreted as follows:

$$L(\beta) = \prod_{i=1}^{N} Pr(y_i = 1|x_i;\beta)^{y_i} Pr(y_i = 0|x_i;\beta)^{1-y_i}, \tag{9}$$

where β is an unknown parameter vector. The previous equation can be converted to a loglikelihood function by substituting $Pr(y_i = 1|x_i;\beta)$ with $F(x_i'\beta)$. Hence,

$$logL(\beta) = \sum_{i=1}^{N} y_i logF(x_i'\beta) + \sum_{i=1}^{N}(1-y_i)log(1-F(x_i'\beta)). \tag{10}$$

This can be maximized by taking first-order conditions with respect to β.

$$\frac{\partial logL(\beta)}{\partial \beta} = \frac{\partial}{\partial \beta} \sum_{i=1}^{N} [y_i log F(x_i'\beta) + (1 - y_i) log(1 - F(x_i'\beta))] \tag{11}$$

$$= \sum_{i=1}^{N} \left\{ y_i \frac{f(x_i'\beta)x_i}{F(x_i'\beta)} + (1 - y_i) \frac{-f(x_i'\beta)x_i}{1 - F(x_i'\beta)} \right\} \tag{12}$$

$$= \sum_{i=1}^{N} \left\{ \frac{y_i}{F(x_i'\beta)} + \frac{1 - y_i}{1 - F(x_i'\beta)} \right\} f(x_i'\beta)x_i \tag{13}$$

$$= \sum_{i=1}^{N} \left\{ \frac{y_i(1 - F(x_i'\beta)) - (1 - y_i)F(x_i'\beta)}{F(x_i'\beta)(1 - F(x_i'\beta))} \right\} f(x_i'\beta)x_i \tag{14}$$

$$= \sum_{i=1}^{N} \left\{ \frac{y_i - F(x_i'\beta)}{F(x_i'\beta)(1 - F(x_i'\beta))} f(x_i'\beta) \right\} x_i = 0. \tag{15}$$

The solution of the previous equation gives the maximum likelihood estimator $\hat{\beta}$ of the pooled panel probit model that allows us to estimate the probability that $y_i = 1$ for a given x_i (Verbeek, 2012). Consequently, the panel probit model allows us to estimate the probability of the onset of a creditless recovery conditional on the explanatory variables. Formally, this can be expressed as

$$Pr(y_{it} = 1 | x_{it}, \hat{\beta}) = F(x_{it}'\hat{\beta}), \tag{16}$$

where y_{it} is the dependent variable in country i at time t, vector x_{it}' contains the chosen explanatory variables, F is the cumulative density function of the standard normal distribution and $\hat{\beta}$ contains the estimates obtained from the panel probit regression (Bijsterbosch & Dahlhaus, 2015).

4.3 Marginal effects

The estimated coefficients of the panel probit model do not have a direct interpretation and therefore, it cannot be directly assessed what happens to probabilities of creditless recoveries as a result of changes in explanatory

variables; the only information that these coefficients provide is about the sign and relative magnitude of these effects, but any conclusions about their absolute magnitude cannot be made (Fernández-Val, 2009). That is why marginal effects will be calculated. The idea of marginal effects is to describe how much the probability of the dependent variable changes if one explanatory variable is changed by one unit, holding all other explanatory variables constant (Williams, 2016). Therefore, the size of a marginal effect depends on the values of all other explanatory variables.

According to Fernández-Val (2009), marginal effects can be determined in two ways; *(i) "either as a change in the conditional outcome probability as a response to a one-unit increase in a regressor, or (ii) as a local approximation based on the slope of the conditional outcome probability"*. By following the example of Bijsterbosch and Dahlhaus (2015), the first one is used. Hence, the marginal effect of a continuous explanatory variable k for country i at time t is calculated as follows:

$$\frac{\partial F(x'_{it}\hat{\beta})}{\partial x_{itk}} = f(x'_{it}\hat{\beta})\hat{\beta}_k. \tag{17}$$

In the equation above, f is the derivative of the standard normal distribution function F (i.e. f is the density function). As Fernández-Val (2009) argues, a common way to calculate marginal effects is to use the average observation of an explanatory variable, meaning that x_{itk} is replaced with the sample average in the previous equation. Therefore, marginal effects measure the instantaneous rate of change in case of a continuous explanatory variable (Williams, 2016).

Since the panel probit model includes both discrete (dummy) and continuous explanatory variables, the computation method of marginal effects differs between these variables. As Williams (2016) argues, the marginal effect for a discrete explanatory variable measures the change of predicted probability as the discrete explanatory variable changes from 0 to 1 (or vice versa), holding all other explanatory variables at their means. Formally,

the marginal effect for a discrete explanatory variable x_l on the predicted probability of y can be calculated as follows:

$$x_l = Pr(y = 1|x_l = 1, \bar{x}, \hat{\beta}) - Pr(y = 1|x_l = 0, \bar{x}, \hat{\beta}), \tag{18}$$

where x_l denote the discrete explanatory variables, $\bar{x}$ the other explanatory variables at their means and $\hat{\beta}$ are the estimates obtained from the panel probit model (Bijsterbosch & Dahlhaus, 2015).

5 Results

Empirical literature and stylized facts presented in this thesis suggest that creditless recoveries are less favorable for economic growth than normal recoveries, and therefore it is crucial to identify the main determinants of creditless recoveries in different country groups. This section introduces and analyzes the main results of this thesis[22]. The analysis follows closely the example of Bijsterbosch and Dahlhaus (2015). First, the pooled panel probit model is estimated in order to shed light on the determinants of creditless recoveries. The estimation is completed by using the random effect panel probit model that controls for heterogeneity across countries included in the sample. The same procedure is implemented for both (i) advanced (section 5.1.1) and (ii) emerging and developing economies (section 5.1.2). Furthermore, this section examines the marginal effects of changes in explanatory variables in both country groups. Finally, some robustness checks are conducted in order to assess the validity of the results.

5.1 Main results

5.1.1 Advanced economies

At first, the pooled panel probit model is estimated using data from 32 advanced economies in the period of 1981–2015[23]. The aim is to explain which variables are essential in determining the likelihood of creditless recoveries. The dependent variable is a creditless recovery dummy, according to the third definition of table 3 (i.e. when the level of real credit in trough year t is higher than in $t+3$). Based on the study of Bijsterbosch and Dahlhaus (2015), the chosen explanatory variables are real GDP growth, credit-to-GDP ratio,

[22]Estimation results are conducted using Stata 13.0 version, which incorporates commands for both the pooled panel probit model and random effects panel probit model.

[23]The number of countries in the sample may vary from a year to another since the panel is unbalanced.

currency crisis (dummy), banking crisis (dummy), current account balance (% of GDP), investment growth and export growth. All of these variables are included in one period lag terms in order to address potential endogeneity problems. Endogeneity problems arise if an explanatory variable is correlated with the error term ε_{it}. The findings are presented in table 6 below.

Model 1 includes only real GDP growth and the credit-to-GDP ratio as explanatory variables. According to model 1, countries that have experienced a sizeable contractions in real GDP growth are more likely to face a creditless recovery next year. This result is statistically significant at 1% level. On the other hand, it appears that credit-to-GDP ratio is an insignificant determinant of creditless recoveries in advanced economies.

Model 2 adds a currency and banking crisis dummy into the regression. The estimation results suggest that only the banking crisis dummy is a significant determinant of creditless recoveries in advanced countries. This indicates that if the recession was preceded by a banking crisis, the following recovery phase is more likely to take place without credit growth. In contrast, currency crisis seems not to be a relevant determinant of creditless recoveries in advanced economies, as it turns out to be statistically insignificant.

Current account balance ratio is taken into account in model 3, but the estimation results show that it is not a statistically significant indicator of creditless recoveries in advanced economies. Interestingly, real GDP growth loses some of its significance in models 2 and 3, but is still significant at 5% significance level in these models.

Finally, model 4 presents the full regression including all seven explanatory variables, as investment and export growth are added into the regression. Investment growth appears to be negative and a highly statistically significant determinant of creditless recoveries in advanced economies. In particular, the likelihood of experiencing a creditless recovery increases in countries that experienced a decline in investment growth. On the other hand, export growth seems not to have a statistically significant effect on

Table 6: Pooled panel probit estimation

Advanced economies

Dependent variable: Creditless recovery	Model 1	Model 2	Model 3	Model 4
Real GDP growth	-7.526***	-4.460**	-4.534**	1.505
	(1.731)	(2.01)	(1.99)	(0.942)
Credit-to-GDP	-0.045	-0.257	-0.227	-0.784*
	(0.227)	(0.305)	(0.3)	(0.401)
Currency crisis		1.008	1.051	1.431
		(0.651)	(0.652)	(0.917)
Banking crisis		2.244***	2.269***	2.013***
		(0.38)	(0.384)	(0.453)
CA/GDP			-1.667	2.805
			(2.538)	(3.451)
Investment growth				-9.646***
				(1.991)
Export growth				1.172
				(1.314)
Constant	-1.767***	-1.926***	-1.951***	-1.895***
	(0.238)	(0.288)	(0.286)	(0.351)
N	973	883	869	838
Pseudo R^2	0.108	0.351	0.353	0.528
Prob > chi2	0.000	0.000	0.000	0.000

Standard errors in parentheses.
Significance levels: *** 1%, ** 5%, * 10%.

the occurrence of creditless recoveries. Comparing model 4 with the other models suggest that real GDP growth loses its significance in the full model, whereas credit-to-GDP is negative and statistically significant at 10 % level in model 4. This finding is somewhat surprising, since it indicates that the

higher credit-to-GDP ratio decreases the likelihood of creditless recovery in advanced economies. However, statistically this result is somewhat questionable because of the low significance of the regressor. Therefore, it is hard to make any strict conclusions from this observation.

To conclude, the estimation results indicate that banking crisis and a decrease in investment growth tend to be the most relevant determinants of creditless recoveries in advanced economies. Real GDP growth loses its explanatory power as more independent variables are included in the regression. However, this may be explained, at least partly, due to the fact that real GDP growth might be correlated with investment growth. The results indicate that if countries experience a banking crisis or a sizeable decline in investment, the following recovery is more likely to be creditless. In addition, the preferred regression (model 4) reaches clearly the highest pseudo R^2, which indicates that this model fits the purpose of analyzing the determinants of creditless recoveries better than the other models. The last row of table 6 indicates that all of these models fit significantly better than a model with no predictors. Furthermore, it should be noted that only the sign and the significance level give us some information about the effects of explanatory variables on the likelihood of creditless recoveries. The actual size of the estimation coefficients in table 6 does not tell us anything about the magnitude of the effects of the explanatory variables.

Table 7 reports the results of random effects panel probit estimation for advanced economies. This method allows us to control the unobserved time-invariant heterogeneity across countries included in the panel data. The results show that all coefficients are practically the same in the pooled and random effects panel probit models. The complete estimation results of model 4 for advanced economies is illustrated in table A4 in the appendix. The estimates of the correlation ρ (the proportion of the total variance contributed by the panel-level variance component) and the standard deviation σ_α are both virtually zero. In addition, a likelihood-ratio test at the bottom of ta-

Table 7: Random effects panel probit estimation

Advanced economies

Dependent variable: Creditless recovery	Model 1	Model 2	Model 3	Model 4
Real GDP growth	-7.526***	-4.460**	-4.534**	1.505
	(1.731)	(2.01)	(1.99)	(0.942)
Credit-to-GDP	-0.045	-0.257	-0.227	-0.784*
	(0.227)	(0.305)	(0.3)	(0.401)
Currency crisis		1.008	1.051	1.431
		(0.651)	(0.652)	(0.917)
Banking crisis		2.244***	2.269***	2.013***
		(0.38)	(0.384)	(0.453)
CA/GDP			-1.667	2.804
			(2.538)	(3.45)
Investment growth				-9.646***
				(1.99)
Export growth				1.172
				(1.314)
Constant	-1.767***	-1.925***	-1.951***	-1.895***
	(0.238)	(0.288)	(0.286)	(0.351)
N	973	883	869	838
Pseudo R^2	0.108	0.351	0.353	0.528
Prob > chi2	0.000	0.000	0.000	0.000

Standard errors in parentheses.
Significance levels: *** 1%, ** 5%, * 10%.

ble A4 in appendix compares the pooled estimator with the random effects estimator. The p-value of the likelihood-ratio test of the hypotheses that $\rho = 0$ is 1.00, so the null hypotheses of no random effects cannot be rejected. Therefore, it can be concluded that the panel-level variance component is

unimportant, and the random effects estimator does not provide different results than the pooled estimator for advanced economies.

5.1.2 Emerging and developing economies

A corresponding analysis for emerging and developing economies is presented in tables 8 and 9. First, table 8 presents the pooled panel probit estimation results for 105 emerging and developing economies in the period of 1981–2015[24]. The results are also compared with the findings of Bijsterbosch and Dahlhaus (2015), who analyzed the determinants of creditless recoveries in 72 emerging and developing countries for the period of 1971–2009[25].

Model 1 contains real GDP growth and credit-to-GDP ratio as explanatory variables. Similarly as in advanced economies, real GDP growth appears to be negative and statistically significant at 1% level in emerging and developing economies, indicating that countries with sizeable contractions in real GDP growth are more likely to experience a creditless recovery in the following year. On the other hand, credit-to-GDP ratio seems not to have a statistically significant effect on the likelihood of the occurrence of creditless recoveries. This finding differs from the results of Bijsterbosch and Dahlhaus (2015) who find that high credit-to-GDP ratio increases the likelihood of a creditless recovery.

Currency and banking crisis dummies are included in model 2, and they both turn out to be positive and statistically significant determinants of creditless recoveries in emerging and developing economies. The results suggest that the likelihood of a creditless recovery increases if a recession was preceded by a currency or banking crisis. This supports the findings of Bijsterbosch and Dahlhaus (2015).

[24]The number of countries in the sample may vary from a year to another since the panel is unbalanced.

[25]However, their panel probit analysis excludes the global financial crisis from the regression.

Table 8: Pooled panel probit estimation

Emerging and developing economies

Dependent variable: Creditless recovery	Model 1	Model 2	Model 3	Model 4
Real GDP growth	-10.428***	-9.792***	-9.892***	-10.752***
	(0.821)	(0.898)	(0.933)	(1.007)
Credit-to-GDP	0.349	0.285	0.268	0.217
	(0.220)	(0.253)	(0.254)	(0.269)
Currency crisis		0.877***	0.876***	0.882***
		(0.234)	(0.234)	(0.238)
Banking crisis		0.974***	0.966***	0.954***
		(0.248)	(0.249)	(0.251)
CA/GDP			0.365	0.460
			(0.375)	(0.386)
Investment growth				-0.045
				(0.088)
Export growth				0.009
				(0.067)
Constant	-1.939***	-1.996***	-1.980***	-1.973***
	(0.089)	(0.097)	(0.099)	(0.105)
N	3116	2816	2813	2709
Pseudo R^2	0.224	0.290	0.289	0.317
Prob > chi2	0.000	0.000	0.000	0.000

Standard errors in parentheses.

Significance levels: *** 1%, ** 5%, * 10%.

Model 3 adds current account balance ratio into the pooled panel probit regression. In contrast to Bijsterbosch and Dahlhaus (2015), the sign of the coefficient of current account balance appears to be a positive but statistically insignificant determinant of creditless recoveries in emerging and developing

economies.

Finally, model 4 presents the full pooled panel probit estimation as investment and export growth are included in the regression. Similarly to Bijsterbosch and Dahlhaus (2015), both investment and export growth are statistically insignificant determinants of creditless recoveries. The full model suggest that in terms of emerging and developing countries, real GDP growth, currency crisis and banking crisis are the most relevant regressors affecting the occurrence of creditless recoveries. Moreover, the full model reaches the highest pseudo R^2 (0.317), conveying that this model fits the purpose of analyzing the determinants of creditless recoveries better than the other models. All in all, the results are quite close to those obtained in Bijsterbosch and Dahlhaus (2015) with the exception of current account balance ratio, which has a different sign and is not a statistically significant variable. In addition, the explanatory power of credit-to-GDP ratio is observed to be insignificant in the case of emerging and developing countries.

Table 9 reports the estimation results of the random effects panel probit model for emerging and advanced economies. The results differ more from the pooled panel probit estimation results than in case of advanced economies, but are still very close to each other. The estimation coefficients have the same signs and statistical significances in both pooled and random effects panel probit regressions. Table A5 in the appendix shows the complete random effects panel probit estimation result of model 4 for emerging and developing economies. The estimates of the correlation ρ (the proportion of the total variance contributed by the panel-level variance component) and the standard deviation σ_α are 0.06 and 0.25, respectively. The p-value of the likelihood-ratio test of the hypotheses that $\rho = 0$ is 0.204, implying that the null hypotheses of no random effects cannot be rejected. Therefore, the panel-level variance component seems to be unimportant, which indicates that the random effects estimator does not provide different results than the pooled estimator.

Table 9: Random effect panel probit estimation

Emerging and developing economies

Dependent variable: Creditless recovery	Model 1	Model 2	Model 3	Model 4
Real GDP growth	-10.428***	-9.885***	-10.035***	-11.429***
	(0.821)	(1.072)	(1.130)	(1.379)
Credit-to-GDP	0.349	0.297	0.285	0.295
	(0.220)	(0.267)	(0.270)	(0.309)
Currency crisis		0.883***	0.884***	0.914***
		(0.238)	(0.239)	(0.248)
Banking crisis		0.980***	0.974***	0.977***
		(0.251)	(0.253)	(0.260)
CA/GDP			0.376	0.512
			(0.381)	(0.403)
Investment growth				-0.051
				(0.091)
Export growth				0.011
				(0.070)
Constant	-1.939***	-2.008***	-1.997***	-2.044***
	(0.089)	(0.124)	(0.126)	(0.150)
N	3116	2816	2813	2709
Pseudo R^2	0.224	0.290	0.289	0.318
Prob > chi2	0.000	0.000	0.000	0.000

Standard errors in parentheses.

Significance levels: *** 1%, ** 5%, * 10%.

5.1.3 Marginal effects

Since the estimated coefficients do not have a direct interpretation, marginal effects will be calculated. Table 10 presents the estimated marginal effects of changes in the explanatory variables for the full model (model 4) in advanced

Table 10: Marginal effects of changes in explanatory variables in advanced economies

Explanatory variable	Marginal effect	Standard error
Real GDP growth	0.006	(0.006)
Credit-to-GDP	-0.003	(0.003)
Currency crisis	0.055	(0.101)
Banking crisis	0.149	(0.117)
CA/GDP	0.012	(0.015)
Investment growth	-0.041	(0.030)
Export growth	0.005	(0.007)

Significance levels: *** 1%, ** 5%, * 10%.

economies. The standard errors are presented in parentheses. The standard errors indicate that none of the marginal effects of explanatory variables are statistically significant in advanced economies, even though banking crisis and investment growth turned out to be statistically significant determinants of creditless recoveries in tables 6 and 7. However, this is not surprising in the sense that panel probit estimation and marginal effects test different hypotheses; the coefficient in a probit model tells whether the effect of an explanatory variable on the likelihood of a creditless recovery is positive or negative, whereas the marginal effect tells the effect of a one unit change in some explanatory variable on the probability of a creditless recovery. In the latter case, each observation has its own effect on the probability of a creditless recovery, which in turn depends on the values of all explanatory variables included in the model. In terms of advanced economies, it can be concluded that the null hypothesis (i.e. the marginal effect equals zero) cannot be rejected.

Table 11 presents the marginal effects of changes in explanatory variables in emerging and developing economies. The size of the marginal effects in-

Table 11: Marginal effects of changes in explanatory variables in emerging and developing economies

Explanatory variable	Marginal effect	Standard error
Real GDP growth	-0.273***	(0.041)
Credit-to-GDP	0.005	(0.007)
Currency crisis	0.060*	(0.032)
Banking crisis	0.071*	(0.038)
CA/GDP	0.012	(0.010)
Investment growth	-0.001	(0.002)
Export growth	0.000	(0.002)

Significance levels: *** 1%, ** 5%, * 10%.

dicate that a preceding decline in real GDP growth tends to increase the probability of a creditless recovery. Moreover, the marginal effect of real GDP growth turns out to be statistically significant. The interpretation is, thus, that if real GDP growth goes up by one unit, the probability of a creditless recovery decreases by 27.3% in emerging and developing economies. This result supports the findings of Bijsterbosch and Dahlhaus (2015), even though the marginal effect is a bit stronger in my findings[26]. Additionally, the marginal effect of currency and banking crisis appears to be positive and statistically significant at 10% level, whereas the rest of the obtained marginal effects of other explanatory variables turn out to be statistically insignificant. Bijsterbosch and Dahlhaus (2015) find also that the marginal effect of current account balance ratio is negative and statistically significant, but the effect remains relatively low when compared to real GDP growth or banking crisis. However, the marginal effect of current account balance ratio turns out to be positive and insignificant in my findings. Another difference

[26]Bijsterbosch and Dahlhaus (2015) find that one-unit increase in real GDP decreases the probability of a creditless recovery by 16.7% in emerging and developing economies.

is that Bijsterbosch and Dahlhaus (2015) do not find currency crisis to be statistically significant. Furthermore, my findings related to banking crises bolster the results of Bijsterbosch and Dahlhaus (2015) that these crises tend to clearly increase the probability of creditless recoveries in emerging and developing economies, even though my results are somewhat milder.

5.2 Robustness checks

This section conducts robustness checks in order to assess the validity of the obtained results by following mainly the example of Bijsterbosch and Dahlhaus (2015). First, the robustness analysis begins by evaluating how sensitive the results obtained in section 5.1 are to different definitions of creditless recoveries[27]. Second, I investigate whether the probit model allows us to analyze the determinants of creditless recoveries rather than the determinants of any other recovery. Finally, the importance of the global financial crisis on the estimated results is assessed by excluding the crisis in both country groups.

Table 12 presents the results of the estimated pooled probit model with all explanatory variables under different definitions of creditless recoveries for advanced economies. Table 12 indicates that a recession that was preceded by a banking crisis and declining investment growth seem to contribute positively to the likelihood that the following recovery will be creditless. Furthermore, the magnitudes of the estimated banking crisis and investment growth coefficients are quite close to each other across different definitions. Comparing the estimation results across different definitions of creditless recoveries points out that the signs of the estimated coefficients remain the same, with the exception of real GDP growth that is positive under definitions 1 and 3 but negative under definitions 2 and 4. However, the real GDP growth is not a statistically significant variable in any of these models. It can be seen from

[27]See table 3, page 18.

table 12 that the results for advanced economies are not remarkably sensitive to different definitions of creditless recoveries. Changing the definition of creditless recoveries does not affect the significance level of explanatory

Table 12: Pooled panel probit estimation for alternative definitions of creditless recoveries in advaced economies

Dependent variable: Creditless recovery	Definition 1	Definition 2	Definition 4
Real GDP growth	1.505	-0.084	-0.084
	(0.942)	(3.675)	(3.675)
Credit-to-GDP	-0.784*	-0.722*	-0.722*
	(0.401)	(0.376)	(0.376)
Currency crisis	1.431	1.144	1.144
	(0.917)	(0.876)	(0.876)
Banking crisis	2.013***	1.894***	1.894***
	(0.453)	(0.436)	(0.436)
CA/GDP	2.805	4.742	4.742
	(3.451)	(3.002)	(3.002)
Investment growth	-9.646***	-7.950***	-7.950***
	(1.991)	(1.943)	(1.943)
Export growth	1.172	1.305	1.305
	(1.314)	(1.354)	(1.354)
Constant	-1.895***	-1.751***	-1.751***
	(0.351)	(0.357)	(0.357)
N	838	838	838
Pseudo R^2	0.528	0.469	0.469

Standard errors in parentheses.
Significance levels: *** 1%, ** 5%, * 10%.

variables, albeit the magnitude of some regressors may vary to some extent. Overall, the results seem to be relatively robust across different definitions of creditless recoveries for advanced economies. In fact, definitions 2 and 4 provide completely identical results, which therefore indicates that these definitions identify exactly the same recovery periods. Moreover, the same applies to definitions 1 and 3, which turn out to provide identical results.

Table 13 presents the corresponding robustness checks of the pooled probit estimation results for emerging and developing economies under different definitions of creditless recoveries. With the exception of export and investment growth (only definition 1), the signs of the coefficients are similar to those obtained under definition 3 of creditless recoveries. Export and investment growth, however, appear to be insignificant determinants of creditless recoveries in all of these models. The magnitude of the estimation coefficients does not seem to differ largely between the different definitions of creditless recoveries. In addition, the findings from table 13 reinforce the view that sizeable contractions in real GDP growth or the presence of a banking or currency crisis before a recession phase would increase the likelihood of a creditless recovery in emerging and developing economies. The estimation coefficients of real GDP growth, banking crisis and currency crisis are also relatively close to each other across the different definitions. Furthermore, current account balance ratio turns out to be positive but insignificant under all definitions of creditless recoveries. Hence, regardless of the definitions of creditless recoveries, the signs and significance levels remain unchanged for emerging and developing economies. The results under definitions 1 and 3, as well as under definitions 2 and 4, turn out to be identical, reflecting that these definitions identify exactly the same recovery periods.

Altogether, the results appear to be relatively robust for different definitions of creditless recoveries in both country groups. Next, another robustness check will be performed which is associated with whether the probit model allows us to analyze the determinants of creditless recoveries rather

than the determinants of any other recovery. Again, this check is made by following the example of Bijsterbosch and Dahlhaus (2015). More specifically, pooled multinomial panel probit estimation checks whether the model

Table 13: Pooled panel probit estimation for alternative definitions of creditless recoveries in emerging and developing economies

Dependent variable: Creditless recovery	Definition 1	Definition 2	Definition 4
Real GDP growth	-11.13***	-10.27***	-10.27***
	(0.992)	(0.990)	(0.990)
Credit-to-GDP	0.150	0.195	0.195
	(0.265)	(0.263)	(0.263)
Currency crisis	0.976***	1.069***	1.069***
	(0.236)	(0.233)	(0.233)
Banking crisis	0.958***	0.686***	0.686***
	(0.251)	(0.261)	(0.261)
CA/GDP	0.623	0.258	0.258
	(0.382)	(0.380)	(0.380)
Investment growth	0.038	-0.045	-0.045
	(0.071)	(0.093)	(0.093)
Export growth	-0.050	0.002	0.002
	(0.064)	(0.072)	(0.072)
Constant	-1.910***	-1.948***	-1.948***
	(0.102)	(0.103)	(0.103)
N	2709	2709	2709
Pseudo R^2	0.327	0.296	0.296

Standard errors in parentheses.
Significance levels: *** 1%, ** 5%, * 10%.

actually distinguishes creditless recoveries from normal recoveries.

In order to do so, the pooled probit model is extended to a multinomial probit model that includes three categories; 1) creditless recovery, 2) normal recovery and 3) no recovery in output. Furthermore, the category of "no recovery in output" is used as a base outcome, meaning that the other two categories are compared to the third. If the obtained coefficient of an explanatory variable in the first category is positive, it means that it is more likely that the recovery would be creditless rather than having no recovery at all. However, this does not mean that it is more likely that the recovery will be creditless rather than normal, because the probability of normal recovery may be greater than the probability of creditless recovery.

Table 14 below presents the estimation results of pooled multinomial panel probit model for advanced economies. Notably, banking and currency crisis dummies cannot be included in the multinomial probit model because in the event of no recovery, crisis dummies do not take on values of one by construction (Bijsterbosch & Dahlhaus, 2015). P-values of the estimation coefficients are presented in parentheses. In addition, marginal effects are included in table 14.

Table 14: Pooled multinomial panel probit estimation with the no recovery event as reference category for advanced economies

	Creditless recovery		**Normal recovery**		**Difference**
	Coefficient	Marginal effect	Coefficient	Marginal effect	
Real GDP growth	1.62 (0.56)	0.021	-15.00 (0.00)	-0.910	16.62
Credit-to-GDP	-0.80 (0.06)	-0.003	-0.92 (0.00)	-0.055	0.12
CA/GDP	6.57 (0.08)	0.033	1.91 (0.38)	0.110	4.66
Investment growth	-14.58 (0.00)	-0.077	1.07 (0.40)	0.077	-15.65
Export growth	0.14 (0.92)	0.002	-1.80 (0.09)	-0.109	1.94

P values in parentheses.

First, looking at the multinomial probit estimation of real GDP growth points out that the coefficient changes sign for normal recoveries, and the

estimated coefficient is negative and statistically significant only in case of normal recoveries. This result suggest that the recovery with credit is more likely when there have been downturns in real GDP growth, whereas real GDP growth is not a statistically significant determinant of creditless recoveries in advanced economies. Second, the coefficient of credit-to-GDP ratio seems to be negative and statistically significant in both categories, even though credit-to-GDP ratio loses its significance level for creditless recoveries. This result indicates that decreasing credit-to-GDP ratio (i.e. deleveraging) increases the likelihood of both creditless and normal recoveries in advanced economies, but the marginal effects suggest that these impacts are very small, particularly in case of creditless recoveries.

Third, the estimated coefficient of current account balance ratio is positive for both categories, which means that a high current account deficit does not typically precede neither creditless nor normal recoveries. In addition, the estimated coefficient is statistically significant (at 10% level) only in case of creditless recoveries. Fourth, the estimated coefficient of investment growth is negative and highly statistically significant in case of creditless recoveries, whereas it changes sign and loses significance for normal recoveries. This result highlights the most pronounced difference between creditless and normal recoveries in advanced economies; creditless recoveries are typically preceded by declining investments, whereas this is not the case with normal recoveries. Finally, export growth is positive and statistically insignificant in case of creditless recoveries, but negative and statistically significant (at 10% level) in case of normal recoveries. This suggests that export growth tends to be an insignificant determinant of creditless recoveries in advanced economies.

Similarly, table 15 presents the estimation results of pooled multinomial panel probit model for emerging and developing economies. First, the estimated coefficient of real GDP growth is negative and statistically significant in both categories, suggesting that downturns in real GDP growth seem to

increase the likelihood of both creditless and normal recoveries relative to the event of no recovery in emerging and developing economies. Moreover, the result highlights that downturns in GDP preceding creditless recoveries appears to be more pronounced than those preceding recoveries with credit. Second, the coefficient of credit-to-GDP ratio changes sign for normal recoveries, but the estimated coefficients seem not to be statistically significant in either of the cases. Third, current account balance ratio is negative and statistically significant in both cases, and the significance increases for normal recoveries. This result indicates that a higher current account deficit would increase the likelihood of both creditless and normal recoveries relative to the event of no recovery in emerging and developing economies. Finally, both investment and export growth are not statistically significant in either of the cases.

When comparing these results with the findings made by Bijsterbosch and Dahlhaus (2015), it can be noted that the estimation results of pooled multinomial probit models are very close to each other in case of emerging and developing economies, even though these results are not, at least fully, comparable because of a different country sample, timeline and data sources. In fact, the results from the multinomial panel probit estimation are very similar with the exception of current account balance ratio, which changes

Table 15: Pooled multinomial panel probit estimation with the no recovery event as reference category in emerging and developing economies

	Creditless recovery		**Normal recovery**		**Difference**
	Coefficient	Marginal effect	Coefficient	Marginal effect	
Real GDP growth	-23.24 (0.00)	-0.321	-17.09 (0.00)	-1.129	-6.15
Credit-to-GDP	0.32 (0.34)	0.006	-0.39 (0.13)	-0.028	0.71
CA/GDP	-1.14 (0.09)	-0.014	-1.62 (0.00)	-0.109	0.48
Investment growth	-0.10 (0.34)	-0.002	0.03 (0.68)	0.002	-0.13
Export growth	0.04 (0.62)	0.001	-0.02 (0.63)	-0.002	0.06

P values in parentheses.

sign for normal recoveries in the analysis made by Bijsterbosch and Dahlhaus (2015), but not in my results.

Next, the implications of the global financial crisis on the estimation results are assessed by excluding the crisis from the sample of both country groups. These results are presented in table 16. As can be seen, excluding the global financial crisis makes the banking crisis variable insignificant in advanced economies, whereas it remains nearly unchanged in the case of emerging and developing economies. This is, in fact, an expected outcome since approximately 80% of observed banking crises happened simultaneously with the recent global financial crisis during the estimation period in advanced economies, whereas the corresponding share was only 14% in emerging and developing countries[28]. Another remarkable change is that the currency crisis becomes a statistically significant variable at 5% level in advanced economies if the global financial crisis is excluded. Because of the fact that currency crises have been rare events during 1981–2015 in advanced economies (only 5 currency crises during this period, of which 4 crises in 1980s), the finding is not surprising. Exclusion of the global financial crisis does not seem to substantially affect the results in the case of emerging and developing economies.

[28]The distribution of banking crises in emerging and developing countries is much more stable compared to advanced countries. For example, the Asian financial crisis (started in 1997) and Latin American debt crisis (in the early 1980s) form a major part of the observed crises in the sample of emerging and developing countries.

Table 16: Pooled panel probit estimation when the global financial crisis is excluded

Dependent variable: Creditless recovery	Advanced economies	Emerging and developing economies
Real GDP growth	1.224	-10.601***
	(2.359)	(1.046)
Credit-to-GDP	-0.695	0.256
	(0.587)	(0.294)
Currency crisis	2.060**	0.902***
	(1.008)	(0.241)
Banking crisis	0.259	0.808***
	(1.057)	(0.272)
CA/GDP	0.661	0.352
	(4.638)	(0.401)
Investment growth	-11.411***	-0.057
	(2.743)	(0.085)
Export growth	2.036	0.018
	(1.947)	(0.064)
Constant	-1.957***	-1.949***
	(0.509)	(0.109)
N	689	2234
Pseudo R^2	0.392	0.310

Standard errors in parentheses.
Significance levels: *** 1%, ** 5%, * 10%.

Additionally, it would be interesting to examine whether the estimation results are sensitive for the country group classification. Since the results obtained in this thesis are based on IMF's WEO database that classifies the world into 1) advanced economies and 2) emerging and developing economies,

other institutions may use different classification methods. For instance, World Bank classifies countries into four different categories based on their gross national income per capita levels: 1) low-income economies, 2) lower-middle-income economies, 3) upper-middle-income economies and 4) high-income economies. Respectively, the main criteria of IMF's country classification are 1) per capita income level, 2) export diversification and 3) degree of integration into the global financial system. Since the World Bank's last category includes practically all the same countries than IMF's "advanced economies"[29], it can be assumed that the estimation results related to advanced/high-income countries would remain very close to each other, regardless of the classification method. Instead, more significant differences could be found among the developing countries. Still, as the major interest of this thesis is to focus on advanced economies, the robustness checks related to sensitivity of country group classification are not presented.

[29]World Bank's high-income category includes also some countries that are classified as emerging countries according to IMF.

6 Discussion

In light of the results obtained in the previous section, it appears that the determinants of creditless recoveries, indeed, are somewhat different between the country groups. The results indicate that only a banking crisis preceding the recession phase seems to be a common, statistically significant determinant of creditless recoveries in both country groups. In advanced economies, also negative investment growth appears to increase the likelihood of creditless recoveries. On the other hand, real GDP growth and currency crisis seemed to have significant contribution to the probability of the occurrence of creditless recoveries in emerging and developing economies. However, the results must be analyzed and discussed in more detail in order to make any profounder conclusions. Hence, the aim of this section is to discuss and integrate the obtained results into a wider context.

According to the obtained results, real GDP growth lost its statistical significance in the case of advanced economies in the full panel probit regression, but this was not the situation in the case of emerging and developing economies. As Calvo et al. (2006b) argue, idle resources may play an important role in rationalizing a speedy post-collapse recovery phase after large contractions of real GDP in emerging economies. Indeed, my analysis supports the findings of Calvo et al. (2006b) in terms of emerging and developing economies. Emerging and developing countries that have experienced large contractions in output may be likely to recover without credit as they may be more likely to exploit existing capacity instead of investing (and therefore borrowing). Investments tend to be highly dependent on bank financing, which in turn indicates that the lack of investment may explain why the recovery phase appears to be creditless (Coricelli & Frigerio, 2015). On the other hand, real GDP growth was not observed to be associated with the increasing probability of creditless recoveries in advanced economies. This may be due to the fact that financial markets tend to be more developed

in advanced economies than in emerging and developing countries. Therefore, even a large contraction in real GDP does not necessarily mean that firms are forced to curtail investments and reduce borrowing or banks are forced to reduce lending to the same extent in advanced economies than in emerging or developing economies. As pointed out by Coricelli and Frigerio (2015), the more developed financial markets may indicate that it is easier for industries dependent on external finance to exploit alternative sources of finance instead of bank credit, such as corporate bonds and equity. Hence, countries that are subject to less developed financial markets may not be able exploit alternative funding sources so well. Therefore, it seems to be more likely that large contractions in output are associated with the observation of increasing probability of creditless recoveries in emerging and developing economies, but not in advanced economies.

Credit-to-GDP ratio appeared to be a negative and statistically significant (at 10% significance level) determinant of creditless recoveries in advanced countries. On the other hand, the estimation coefficient was positive and insignificant in the case of emerging and developing economies. In the case of advanced economies, the result is somewhat surprising; it says that higher private sector indebtedness would be associated with lower probability of creditless recoveries. This finding may indicate that firms and households in advanced economies may not be afraid of taking new credit from banks even if their overall level of indebtedness is high. However, the obtained result is somewhat suspicious statistically and no direct conclusions should be drawn. This view is also confirmed by the fact that credit-to-GDP ratio was not statistically significant in models 1-3. On the contrary, Bijsterbosch and Dahlhaus (2015) found that a high credit-to-GDP ratio would be associated with higher probability of creditless recoveries in emerging and developing economies, as firms may be willing to deleverage, especially after the contraction in output. Furthermore, a high credit-to-GDP ratio may indicate that an economy has faced a credit boom, which in turn may negatively

affect on banks' willingness to grant new loans. My findings in terms of emerging and developing countries are parallel to those of Bijsterbosch and Dahlhaus (2015) with the exception that they are not statistically significant. At least partly, this difference can be explained by a different country sample and time span. In addition, Bijsterbosch and Dahlhaus (2015) excluded the global financial crisis from their analysis. As pointed out in this thesis, a substantial part of creditless recoveries in both country groups occurred in the aftermath of the global financial crisis, which in turn may explain even significant differences between these results. Indeed, excluding the global financial crisis indicates that credit-to-GDP loses its statistical significance as an explanatory variable for advanced economies, but there are no significant changes in results in the case of emerging and developing economies.

As expected, banking crisis turned out to be a positive and statistically significant determinant of creditless recoveries in both country groups. Typically, banking crises tend to require considerable actions from banks in order to ensure their functional capability. Banks that are suffering severe losses during banking crises are facing not only rising costs but also liability rationing as they either need to contract deposits in order to satisfy their regulatory capital requirement, or because depositors may prefer to place their funds in more stable intermediaries or markets (Laeven & Valencia, 2013). Thus, these difficulties may be reflected in the form of reduced bank lending and, therefore, increased probability of creditless recoveries in the wake of banking crises. Bijsterbosch and Dahlhaus (2015) argue that typical balance sheet clean up by banks takes usually at least a couple of years during which they are likely to be forced to curtail lending. This, indeed, indicates that a recovery phase that was preceded by a banking crisis is likely to be creditless. If the global financial crisis is excluded from the analysis, the results indicate that banking crisis loses its statistical significance as a regressor for advanced economies. This, in turn, reinforces the view that the global financial crisis has been a unique incident in the economic history of advanced countries.

Contrarily, the results remain nearly unchanged if the global financial crisis is excluded in terms of emerging and developing economies.

Similarly to the case of banking crises, the estimation coefficients of currency crises were also positive for both country groups. However, currency crisis appeared to be statistically significant only in terms of emerging and developing economies. This is not surprising since currency crises have been much more common in less developed countries relative to advanced countries during the estimation period[30]. This difference is likely to be based, at least partly, on the differences between financial markets across country groups. As Bijsterbosch and Dahlhaus (2015) argue, a currency crisis may lead to a reduction of investments from abroad because of arising uncertainty among international investors. They state that this is more likely to happen and thereby influence bank lending in emerging and developing economies, since the financial markets are typically less developed in these countries. In addition, currency crises are often associated with disruptions in capital flows, which are closely connected with creditless recoveries (Calvo et al., 2006a). According to Laeven and Valencia (2013), an important caveat related to currency crises is its sensitive definition. Laeven and Valencia (2013) define currency crises as *"a nominal depreciation of the currency in vis-a-vis the U.S. dollar of at least 30 percent that is also at least 10 percentage points higher than the rate of depreciation in the year before"*. They argue that changes in these thresholds may lead to substantial changes in the observations of currency crises. The results obtained in this thesis are also subject to the above mentioned definition of currency crises and, hence, changing the thresholds would possibly affect the estimation results.

In the full regression model, current account balance ratio turned out to be unexpectedly positive and insignificant for both country groups. Based on this finding, it is not possible to conclude that higher current account

[30]During 1981-2011, advanced economies experienced only 5 currency crises, whereas the corresponding number was 44 in emerging and developing economies.

deficit would increase the likelihood of creditless recoveries. Bijsterbosch and Dahlhaus (2015), in turn, found some evidence of increasing impact of higher current account deficit on the likelihood of creditless recoveries in emerging and developing countries. Besides the fact that the deviating results may be partly explained by a different country sample and time span, other interpretative conclusions are hard to identify. Typically, a high current account deficit indicates that an economy is dependent on foreign capital inflows that can be used to finance the domestic banking system and domestic consumption. However, such evidence is not found from the results of this thesis.

The estimation coefficient of investment growth appeared to be a negative and highly statistically significant determinant of creditless recoveries in advanced economies, but insignificant in emerging and developing economies. This finding is in line with the initial expectations. As pointed out by Calvo et al. (2006b), one way to boost liquidity and eventually output in the aftermath of a "liquidity crunch" is to curtail investments and therefore borrowing from banks. Hence, output recovery seems to be more likely to happen without credit growth if economies are forced to discontinue investment projects in order to restore liquidity, particularly in advanced economies. Furthermore, as Coricelli and Frigerio (2015) argue, the observed subdued growth associated with creditless recoveries may be explained by a shift away from more to less credit-intensive activities. Since investments are often perceived to be highly dependent on credit, the obtained results support the view that a preceding investment decline would be associated with the increasing likelihood of creditless recoveries in advanced economies. As more credit-dependent activities usually tend to produce higher productivity growth compared to less credit-dependent ones, it makes sense that this kind of reallocation of resources based on credit intensity of production is associated with an inefficient outcome (Coricelli & Frigerio, 2015). Therefore, it is expected that the reduction in investments prior to the recovery phase is likely to lead to

an observation of a creditless recovery in advanced economies. On the other hand, the findings support the results of Bijsterbosch and Dahlhaus (2015) in terms of emerging and developing economies. In these countries, investment growth seems to be a less relevant determinant of creditless recoveries.

Lastly, the model was supplemented by an export growth variable. The expectation for this variable was that if more credit-intensive domestic expenditure components would remain muted, export growth might be a key driver of creditless recoveries. According to the obtained results, however, there was no statistically significant evidence that export growth would contribute to the probability of creditless recoveries in neither of the country groups. These findings are in line with those made by Bijsterbosch and Dahlhaus (2015).

It must be noted that a number of other variables that have been left out from the model may potentially affect and improve the performance of the final outcome. The selection of the variables used in this thesis was based entirely on the example of Bijsterbosch and Dahlhaus (2015). As they argue in their study, several excluded variables might be relevant in explaining determinants of creditless recoveries. For instance, trade credit would potentially be a useful indicator that could capture the effect of alternative sources of financing. On the other hand, several factors such as interest rates or asset prices could give some indication about financial constraints or wealth effects of economies. Additionally, several fiscal variables may potentially be useful as sovereign level problems may affect the private sectors ability to borrow and thereby prevent credit from increasing as demand recovers. However, Bijsterbosch and Dahlhaus (2015) excluded these variables from their analysis because of the data limitations or the fact that they were highly statistically insignificant.

Even though this thesis uses the same estimation methodology and explanatory variables as Bijsterbosch and Dahlhaus (2015), it adds values around their research. First of all, this thesis approaches the subject from a

different perspective as the main interest lies on advanced economies. As the results suggest, clear differences in the determinants of creditless recoveries can be found between the country groups. Another advantage of this thesis compared to Bijsterbosch and Dahlhaus (2015) is that the time period covers the global financial crisis of 2007-2009 that has turned out to be associated strongly on creditless recoveries in advanced, but also in emerging and developing countries. Finally, the similar analysis of both country groups allows us to compare the country group specific differences in the results directly througout the empirical part of the thesis. However, this thesis does not take a stand on the real reasons behind the estimation results. In other words, the presented discussions are only speculative and are based on arguments made in previous literature of creditless recoveries.

7 Conclusions

This thesis analyses the main determinants of creditless recoveries in both (i) advanced and (ii) emerging and developing economies by using a panel probit estimation method and compares the differences between these country groups. The global financial crisis of 2007–2009 has, at the latest, raised the phenomenon of creditless recovery to the forefront of economic research. As several years have already passed since the emergence of the global financial crisis, there appears to be enough data to allow the crisis to be included in the analysis.

The existing literature clearly shows that creditless recoveries are not rare events in advanced or emerging and developing economies. According to some estimates, approximately one-fifth of all recoveries can be classified as creditless, and the frequency appears to be higher in emerging and developing countries compared to advanced economies. My findings support this view. Notably, it seems that the recent global financial crisis has substantially increased the prevalence of creditless recoveries particularly in advanced economies; according to my analysis, 19% of all recoveries have been creditless in advanced economies during 1980–2015. The previous studies — in which data does not (at least fully) cover the recent global financial crisis — have estimated that the frequency of creditless recoveries is near 10% of all recoveries in advanced economies. My findings also indicate that creditless recoveries are associated with weaker real GDP growth rates compared to normal recoveries both in (i) advanced and (ii) emerging and developing countries.

The empirical results obtained in this thesis suggest that there seems to be both common and diverging factors affecting the probability of creditless recovery between the country groups. The results suggest that a banking crisis that preceded a recession is a major factor increasing the probability of a creditless recovery in both country groups. The probability of a creditless

recovery is likely to increase due to the fact that a banking crisis typically forces banks to clean up their balance sheets and thus reduce lending. Furthermore, the results were not significantly dependent on whether the model used was a pooled or random effects panel probit model, as both provided very similar results.

According to my analysis, investment growth appears to be the most important determinant, alongside the banking crisis, of creditless recoveries in advanced economies. The results suggest that declining investments preceding an economic downturn will significantly increase the likelihood of creditless recoveries. This finding may be based on several possible explanations. First, if the liquidity crunch has occurred, firms may boost their liquidity and eventually output by curtailing investments and thus borrowing (Calvo et al., 2006b). Second, creditless recoveries may be explained by a shift from more to less credit-intensive activities (Coricelli & Frigerio, 2015). Since investments usually require bank financing, a contraction of investments may be the reason behind the increased likelihood of creditless recoveries in advanced economies. However, this seems not to be the case in emerging and developing countries. In contrast, sizeable contractions in real GDP together with currency crises are likely to increase the probability of creditless recoveries in emerging and developing economies, but these were not found to be statistically significant factors in advanced economies.

The results of this thesis in terms of emerging and developing countries are mostly in line with the empirical findings of Bijsterbosch and Dahlhaus (2015), with the exception of current account balance ratio, which surprisingly turned out to be an insignificant determinant of creditless recoveries. Overall, the observed differences between country groups may reflect various aspects. Advanced economies are likely to have more developed financial markets, which may make it easier for firms to exploit alternative sources of financing. Therefore, output may recover easier without bank credit growth in advanced economies since firms and households have better access to other

funding sources. It seems that even the global financial crisis has not closed this gap between the country groups.

The recent global financial crisis has shown that the ability of an economy to recover smoothly from recessions is undeniably important to the well-being of households, firms and eventually countries all around the world. In the future, more attention should be paid on minimizing the negative impacts following financial crises or deep recessions. By identifying factors that increase the likelihood of creditless recoveries, we are one step closer. This study provides added value to the existing empirical research of creditless recoveries by shifting the focus more on advanced economies and taking the global financial crisis into account. As the global financial crisis has shown, also advanced economies are prone to creditless recoveries. Although this thesis contributes to the existing literature by exploring factors behind creditless recoveries in advanced economies in more detail, more research is still needed for improving our understanding on how to construct and target optimal country-specific policy measures in order to prevent and mitigate the negative effects of creditless recoveries on economic growth.

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Appendix

Country classification in Table A1 is based on International Monetary Funds (IMF) World Economic Outlook (WEO), October 2016. Plenty of countries are excluded from the sample because of data limitations. These countries are Cyprus, Puerto Rico, San Marino and Taiwan Province of China (advanced economies) and Afghanistan, Iraq, Kiribati, Marshall Islands, Palau, South Sudan, Turkmenistan, Tuvalu and Uzbekistan (emerging and developing economies). In addition, 2 advanced and 37 emerging/developing countries from table A1 were excluded from empirical analysis due to the lack of data in terms of some explanatory variables[31]. These countries are:

1. **Advanced economies**

    - Malta, Macao SAR

2. **Emerging and developing economies**

    - Angola, Antiqua and Barbuda, The Bahamas, Bahrain, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Eritrea, Guinea, Kosovo, Lao P.D.R., Liberia, Libya, Maldives, Micronesia, Moldova, Montenegro, Myanmar, Oman, Qatar, Samoa, Sao Tome and Principe, Saudi Arabia, Solomon Islands, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Syria, Tajikistan, Timor-Leste, Tonga, United Arab Emirates, Vanuatu, Zimbabwe

[31]However, these countries are included in "stylized fact" part in section 3.

Table A1: Countries in the Sample, by Country Group

Advanced economies		**Emerging and developing economies**					
1	Australia	1	Albania	49	Gambia	97	Papua New Guinea
2	Austria	2	Algeria	50	Georgia	98	Paraguay
3	Belgium	3	Angola	51	Ghana	99	Peru
4	Canada	4	Antigua and Barbuda	52	Grenada	100	Philippines
5	Czech Republic	5	Argentina	53	Guatemala	101	Poland
6	Denmark	6	Armenia	54	Guinea	102	Qatar
7	Estonia	7	Azerbaijan	55	Guinea-Bissau	103	Republic of Congo
8	Finland	8	The Bahamas	56	Guyana	104	Romania
9	France	9	Bahrain	57	Haiti	105	Russia
10	Germany	10	Bangladesh	58	Honduras	106	Rwanda
11	Greece	11	Barbados	59	Hungary	107	Samoa
12	Hong Kong SAR	12	Belarus	60	India	108	Sao Tome and Principe
13	Iceland	13	Belize	61	Indonesia	109	Saudi Arabia
14	Ireland	14	Benin	62	Iran	110	Senegal
15	Israel	15	Bhutan	63	Jamaica	111	Serbia
16	Italy	16	Bolivia	64	Jordan	112	Seychelles
17	Japan	17	Bosnia and Herzegovina	65	Kazakhstan	113	Sierra Leone
18	Korea	18	Botswana	66	Kenya	114	Solomon Islands
19	Latvia	19	Brazil	67	Kosovo	115	South Africa
20	Lithuania	20	Brunei Darussalam	68	Kuwait	116	Sri Lanka
21	Luxembourg	21	Bulgaria	69	Kyrgyz Republic	117	St. Kitts and Nevis
22	Malta	22	Burkina Faso	70	Lao P.D.R.	118	St. Lucia
23	Macao SAR	23	Burundi	71	Lebanon	119	St. Vincent and the Grenadines
24	Netherlands	24	Cabo Verde	72	Lesotho	120	Sudan
25	New Zealand	25	Cambodia	73	Liberia	121	Suriname
26	Norway	26	Cameroon	74	Libya	122	Swaziland
27	Portugal	27	Central African Republic	75	Madagascar	123	Syria
28	Singapore	28	Chad	76	Malawi	124	Tajikistan
29	Slovak Republic	29	Chile	77	Malaysia	125	Tanzania
30	Slovenia	30	China	78	Maldives	126	Thailand
31	Spain	31	Colombia	79	Mali	127	Timor-Leste
32	Sweden	32	Comoros	80	Mauritius	128	Togo
33	Switzerland	33	Costa Rica	81	Mexico	129	Tonga
34	United Kingdom	34	Cote d'Ivoire	82	Micronesia	130	Trinidad and Tobago
35	United States	35	Croatia	83	Moldova	131	Tunisia
		36	Democratic Republic of the Congo	84	Mongolia	132	Turkey
		37	Djibouti	85	Montenegro	133	Uganda
		38	Dominica	86	Morocco	134	Ukraine
		39	Dominican Republic	87	Mozambique	135	United Arab Emirates
		40	Ecuador	88	Myanmar	136	Uruguay
		41	Egypt	89	Namibia	137	Vanuatu
		42	El Salvador	90	Nepal	138	Venezuela
		43	Equatorial Guinea	91	Nicaragua	139	Vietnam
		44	Eritrea	92	Niger	140	Yemen
		45	Ethiopia	93	Nigeria	141	Zambia
		46	Fiji	94	Oman	142	Zimbabwe
		47	FYR Macedonia	95	Pakistan		
		48	Gabon	96	Panama		

Table A2: Recovery Episodes and Trough Dates in Advanced Economies

	Trough Date					All	Creditless	No credit data
Australia	1983	1991				2	0	0
Austria	1988	2003	2009			3	0	0
Belgium	**1981**	1987	[1996]	2003	**2009**	5	2	1
Canada	1986	1992	1998	[2009]		4	0	1
Czech Republic	[1992]	2003	[2013]			3	0	2
Denmark	1981	**1993**	2003	**2009**		4	2	0
Estonia	1995	**2009**				2	1	0
Finland	1987	**1993**	2009			3	1	0
France	1987	2009				2	0	0
Germany	1988	2005	**2009**			3	1	0
Greece	**1987**	2005	[2013]*			3	1	1
Hong Kong SAR	[1985]	**1998**	2003	2009		4	1	1
Iceland	1981	1996				2	0	0
Ireland	**2010**	[2014]				2	1	1
Israel	1989	1994				2	0	0
Italy	1987	**1993**	[1999]	2009		4	1	1
Japan	1983	1987	2009	2011		4	0	0
Korea	1980	1998	2009			3	0	0
Latvia	[1992]	1995	**2010**			3	1	1
Lithuania	1995*	[2009]				2	0	1
Luxembourg	1987	[1998]	2004*	**2009**		4	1	1
Malta	1990	2005				2	0	0
Macao SAR	2002	2009				2	0	0
Netherlands	1987	[1996]	2005			3	0	1
New Zealand	1984	1992	[2013]			3	0	1
Norway	1982	**1989**	1994			3	1	0
Portugal	**1984**	[1996]	**2012**			3	2	1
Singapore	1986	1998	2003*	2009		4	0	0
Slovak Republic	[1992]	2009				2	0	1
Slovenia	2005	[2013]*				2	0	1
Spain	1985	2004	[2013]*			3	0	1
Sweden	**1992**					1	1	0
Switzerland						0	0	0
United Kingdom	1981	1986	1992	**2009**		4	1	0
United States	1982	1991*	2002	**2009**		4	1	0
Total						100	19	17

***Creditless recoveries according to definitions 2 and 4**
bold = creditless recovery
date in paranthesis = credit data unavailable

Source: Author's calculations.

Table A3: Recovery Episodes and Trough Dates in Advanced Economies

	Trough Date						All	Creditless	No credit data
Albania	**1992**	1997					2	1	0
Algeria	1981	**1988**	**1994**	2001			4	2	0
Angola	[1993]	2004					2	0	1
Antigua and Barbuda	1982	1995	2002	2004	[2010]		5	0	1
Argentina	1985	1990	**2002**	2009			4	1	0
Armenia	**1993**	[2009]					2	1	1
Azerbaijan	1995	2004					2	0	0
The Bahamas	1981	1992	2004	**2009**			4	1	0
Bahrain	1981*	**1987**	1991	1997	2002		5	1	0
Bangladesh	1982	1988	2002				3	0	0
Barbados	1982	1992	2004				3	0	0
Belarus	1995						1	0	0
Belize	**1982**	1986	1998				3	1	0
Benin	1984	**1989**	2005	2011			4	1	0
Bhutan	1986	1994*	2006				3	0	0
Bolivia	**1983**	1986	**2003**				3	2	0
Bosnia and Herzegovina	[1996]						1	0	1
Botswana	1986	**1994**	2009				3	1	0
Brazil	**1983**	**1992**	2009	[2015]			4	2	1
Brunei Darussalam	[1998]	**2009**					2	1	1
Bulgaria	[1985]	**1993**	1997				3	1	1
Burkina Faso	1984	**1990**	1994	2009			4	1	0
Burundi	1980	1984	1996*	[2015]			4	0	1
Cabo Verde	**1982**	1992	2005	2010			4	1	0
Cambodia	[1990]	1998	2003	2009			4	0	1
Cameroon	1980	**1988**	**1994**				3	2	0
Central African Republic	**1983**	[2013]*					2	1	1
Chad	1982	2000	2002	2009			4	0	0
Chile	1983	2009					2	0	0
China	[1983]	1991					2	0	1
Colombia	**1985**	1992	**1999**	2010			4	2	0
Comoros	1989	**1991**	**1994**	1996			4	2	0
Costa Rica	**1982**	1991	1996	2002	2009		5	1	0
Cote d'Ivoire	1984	**1992**	2011				3	1	0
Croatia	[1994]						1	0	1
Democratic Republic of the Congo	[1993]*	2001					2	0	1
Djibouti	**1996**	2010*					2	1	0
Dominica	1980	1985*	1994	2002	2005	**2012**	6	1	0
Dominican Republic	1985	1991	2004				3	0	0
Ecuador	1983	**1987**	**2000**	2003	2010	[2015]	6	2	1

bold = creditless recovery

date in paranthesis = credit data unavailable

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	Trough Date						All	Creditless	No credit data
Egypt	1981	1992	2005				3	0	0
El Salvador	1982	**1989**	1991	**2009**			4	2	0
Equatorial Guinea	1995	1999	2006				3	0	0
Eritrea	**2001**	**2008**					2	2	0
Ethiopia	1985	1992	1998	2003			4	0	0
Fiji	1983	1987	1998				3	0	0
FYR Macedonia	**1995**	2003	2012				3	1	0
Gabon	**1987**	2009					2	1	0
Gambia	1981*	2002*					2	0	0
Georgia	**1995**	2002	2009				3	1	0
Ghana	1983	2010	[2015]				3	0	1
Grenada	1997	2002	2004	**2012**			4	1	0
Guatemala	**1983**	1986	2005	2010			4	1	0
Guinea	[1984]	[1987]	1992	2010	[2015]		5	0	3
Guinea-Bissau	**1998**						1	1	0
Guyana	1983*	**1990**	**2005**				3	2	0
Haiti	[1994]	**2004**	2010				3	1	1
Honduras	1983	1986	1991	1994	**1999**	2009	6	1	0
Hungary	**1991**	**2009**					2	2	0
India	1987	1991	1993	2002	2008		5	0	0
Indonesia	**1998**						1	1	0
Iran	**1981**	1988					2	1	0
Jamaica	1985	1988	**1998**	2010			4	1	0
Jordan	1980	1985	1991				3	0	0
Kazakhstan	**1995**	1999	**2009**				3	2	0
Kenya	1985	1993	2003	2009			4	0	0
Kosovo	2002	2006					2	0	0
Kuwait	[1991]						1	0	1
Kyrgyz Republic	**1995**	2012					2	1	0
Lao P.D.R.	[1980]	[1983]	[1988]				3	0	3
Lebanon	[1982]	**1990**					2	1	1
Lesotho	1987	**1999**	2005	[2015]			4	1	1
Liberia	2003						1	0	0
Libya	2011						1	0	0
Madagascar	1982	2002					2	0	0
Malawi	**1981**	**1992**	**1994**	2003			4	3	0
Malaysia	1987	**1998**	2009				3	1	0
Maldives	[1983]	[1990]	2002	2005	**2009**		5	1	2
Mali	**1982**	1988	2000	[2013]			4	1	1
Mauritania	[1994]	[2002]	[2004]	2009*			4	0	3

bold = creditless recovery

date in paranthesis = credit data unavailable

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	Trough Date						All	Creditless	No credit data
Mauritius	1984	1999	2002	2005			4	0	0
Mexico	**1980**	1983	**1995**	2003	2009		5	2	0
Micronesia	1997	2008					2	0	0
Moldova	1994	2009					2	0	0
Mongolia	1993	2010	[2015]				3	0	1
Montenegro	2005	2012*					2	0	0
Morocco	1981	[1987]	1993	1995	**2000**		5	1	1
Mozambique	**1984**	**1986**	**1992**	1995	**2000**		5	4	0
Myanmar	[2011]						1	0	1
Namibia	1990	2001	2009				3	0	0
Nepal	1980	1983	1987	1993			4	0	0
Nicaragua	**1980**	1988	**1993**	2003	2009		5	2	0
Niger	1984	1995*	1997	2000			4	0	0
Nigeria	2001*						1	0	0
Oman	1980	1982	1987	**1999**			4	1	0
Pakistan	1984	2003	**2010**				3	1	0
Panama	1980	1988	2010				3	0	0
Papua New Guinea	**1990**	**1997**					2	2	0
Paraguay	**1980**	**1983**	**2002**	2009	2012		5	3	0
Peru	**1983**	1990	1992				3	1	0
Philippines	1980	**1985**					2	1	0
Poland	[1982]	**1991**					2	1	1
Qatar	[1983]	[1985]	[1991]	[1996]	2003	2005	6	0	4
Republic of Congo	**1987**	1994	**1999**				3	2	0
Romania	[1992]	1999					2	0	1
Russia	**1994**	1998	2009				3	1	0
Rwanda	1994						1	0	0
Samoa	1982*	**1991**	**1993**	1999	2010		5	2	0
So Tom and Prncipe	[1981]	[1984]	[1987]	2002			4	0	3
Saudi Arabia	1983	1985	**1987**	**1989**	2002		5	2	0
Senegal	**1980**	**1983**	1994	2002			4	2	0
Serbia	1999						1	0	0
Seychelles	**1983**	1995	2004				3	1	0
Sierra Leone	**1992**	**1997**	1999*	[2015]			4	2	1
Solomon Islands	2002	**2009**					2	1	0
South Africa	1980	1983	1986	1992	**2009**		5	1	0
Sri Lanka	**1989**	1992	1995	2001	2009		5	1	0
St. Kitts and Nevis	1983	2003	**2012**				3	1	0
St. Lucia	1984	1987	1997	2002			4	0	0
St. Vincent and the Grenadines	1987	1994	2001	2010			4	0	0

bold = creditless recovery

date in paranthesis = credit data unavailable

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	Trough Date						All	Creditless	No credit data
Sudan	**1985**	**1996**	2005				3	2	0
Suriname	1987	**1991**	1994				3	1	0
Swaziland	1980	**1983**	1985				3	1	0
Syria	1980	**1984**	1987	1989	2003		5	1	0
Tajikistan	[1995]						1	0	1
Tanzania	[1984]	**1994**	2006				3	1	1
Thailand	1986	**1998**	2009				3	1	0
Timor-Leste	[2000]	**2006**					2	1	1
Togo	1983*	**1987**	**1993**				3	2	0
Tonga	1983	**1989**					2	1	0
Trinidad and Tobago	1980	**2002**	**2009**				3	2	0
Tunisia	1982	1986	1989	1995*	2002	2011	6	0	0
Turkey	1989	1994	2001	2009			4	0	0
Uganda	[1980]	1986					2	0	1
Ukraine	**1994**	**2009**	[2015]				3	2	1
United Arab Emirates	1980	1988					2	0	0
Uruguay	**1985**	1991	1995	**2002**			4	2	0
Vanuatu	1989	1993	2002				3	0	0
Venezuela	1983	1989	2003	2010			4	0	0
Vietnam	[1981]	[1987]	[1991]	1999			4	0	3
Yemen	[2011]	[2015]					2	0	2
Zambia	1994						1	0	0
Zimbabwe	[2008]						1	0	1
Total							**449**	**113**	**55**

***Creditless recoveries according to definitions 2 and 4**
bold = creditless recovery
date in paranthesis = credit data unavailable

Source: Author's calculations.

Table A4: Random effects panel probit estimation in advanced economies

Dependent variable: Creditless recovery	Coef.	Std. Err	z	P>|z|	[95% Conf.	Interval]
Real GDP growth	1.504514	0.9422838	1.6	0.11	-0.3423282	3.351357
Credit-to-GDP	-0.783839	0.401375	-1.95	0.051	-1.570519	0.0028415
Currency crisis	1.430806	0.9174176	1.56	0.119	-0.3672997	3.228911
Banking crisis	2.012531	0.4525546	4.45	0.000	1.12554	2.899522
CA/GDP	2.80449	3.450234	0.81	0.416	-3.957845	9.566824
Investment growth	-9.645914	1.990409	-4.85	0.000	-13.54705	-5.744783
Export growth	1.171643	1.313636	0.89	0.372	-1.403035	3.746322
Constant	-1.895125	0.3507235	-5.4	0.000	-2.58253	-1.207719
/lnsig2u	-15.38234	701.7644			-1390.815	1360.051
sigma_u	0.0004568	0.1602986			9.7E-303	2.1E+295
rho	2.09E-07	0.0001465			0	.
Likelihood-ratio test of rho=0:		chibar2(01) = 0.00			Prob >= chibar2 = 1.000	

Table A5: Random effects panel probit estimation in emerging and developing economies

Dependent variable: Creditless recovery	Coef.	Std. Err	z	P>|z|	[95% Conf.	Interval]
Real GDP growth	-11.42887	1.378565	-8.29	0.000	-14.13081	-8.726934
Credit-to-GDP	0.2945253	0.3090893	0.95	0.341	-0.3112785	0.9003292
Currency crisis	0.9144517	0.2481464	3.69	0.000	0.4280937	1.40081
Banking crisis	0.976579	0.2598473	3.76	0.000	0.4672877	1.48587
CA/GDP	0.5119982	0.4028258	1.27	0.204	-0.2775259	1.301522
Investment growth	-0.0506838	0.0913781	-0.55	0.579	-0.2297816	0.1284141
Export growth	0.0111705	0.0698123	0.16	0.873	-0.1256592	0.1480001
Constant	-2.044412	0.1502486	-13.61	0.000	-2.338894	-1.74993
/lnsig2u	-2.744168	1.442399			-5.571218	0.0828817
sigma_u	0.2535779	0.1828803			0.0616915	1.042312
rho	0.0604169	0.0818802			0.0037914	0.5207086
Likelihood-ratio test of rho=0:		chibar2(01) = 0.69			Prob >= chibar2 = 0.204	

Data Appendix

Table A6: Data definitions and sources

Variable	Definitions and Sources
Gross Domestic Product	Real Gross Domestic Product. Sources: IMF IFS, IMF WEO (October 2016) and OECD National Accounts.
Credit	Credit to the Private Sector, converted into real terms by dividing it by the GDP deflator from WDI. Source: IMF IFS.
GDP Deflator	The ratio of GDP in current local currency to GDP in constant local currency. The base year varies by country. Source: World Bank's World Development Indicators (WDI) database.
Banking crisis dummy	Source: Laeven and Valencia (2012) database.
Currency crisis dummy	Source: Laeven and Valencia (2012) database.
Current Account Balance	Current Account Balance, % of GDP. Current account is all transactions other than those in financial and capital items. The major classifications are goods and services, income and current transfers. Source: IMF WEO (October 2016).
Investment	Gross Fixed Capital Formation. GFCF is measured by the total value of a producer's acquisitions, less disposals of fixed assets during the accounting period, plus certain additions to value of nonproduced assets (such as subsoil assets or major improvements in quantity, quality, or productivity of land). Source: IMF IFS.
Export	Exports of goods and services. Source: IMF IFS.